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TECHNICAL MANUAL
FREQUENCY CONVERTER
MODEL 152A-1
10785A

POWER FREQUENCY CONVERTERS

SOLID-STATE INVERTERS

UPS APPLICATIONS

SUNVERTERS®

abacus controls inc.

80 READINGTON ROAD
SOMERVILLE, NJ 08876
(201) 526-6010

APPLICATION		REVISIONS			
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TECHNICAL MANUAL
FREQUENCY CONVERTER
MODEL 152A-1
10785A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS 3 PLC ± .010 2 PLC ± .00 ANGLES ± 1/2°	CONTRACT NO.	abacus controls inc.	80 READINGTON ROAD SOMERVILLE, N. J. 08876
	DRAWN 11/20/84 jl	TECHNICAL MANUAL FREQUENCY CONVERTER MODEL 152A-1	
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1.0 GENERAL INFORMATION

1.1 The Model 152A-1 Frequency Converter accepts an input of 115VAC plus or minus 10% at 47-65Hz and converts it into regulated 115VAC, 400Hz power at a rating of 500VA. Detailed specifications are given in Table 1-1.

1.2 This equipment uses a technique known as Sinewave Synthesis to generate and control the 400Hz output. A pulse pattern is stored on a PROM and is so designed that there are no low-order harmonics present. This makes output filtering simple, as only a low-pass filter is needed. Because there are no sharply resonant circuits in the filter, the Frequency Converter can operate into any power factor without damage.

1.3 The Model 152A-1 features a modular design approach; most of the electronic circuitry is on four printed circuit modules and two heatsink mounted output power modules.

1.4 Refer to outline drawing 22096 in Section 7 of this manual. The front panel has the input circuit breaker with power on indicator lamp. The intake air grill, input/output connectors and access cover for the printed circuit modules are all on the rear panel.

TABLE 1-1 SPECIFICATIONS

ITEM	DESCRIPTION
Model Number	152A-1
Type	Power Frequency Converter
Input	115VAC ± 10%, 47-65Hz, Single Phase, 10 Amp Circuit
Output	
Voltage	115VAC ± 2%, Adjustable 100-130VAC
Frequency	400Hz ± .05%
Power	500VA, 0.7 Lag to 0.7 Lead Power Factor, 0 Lag to 0 Lead Without Damage
THD	4% Maximum, 3% Maximum any Single Harmonic
Protection	Circuit Breaker on Input. Current Limiting on Output. Short-Circuit Proof with Automatic Re-Start Upon Removal of Short Circuit.
Dimensions	19"W x 20"D X 3½"H
Weight	50 Pounds
Mounting	Standard 19-Inch Rack
Connectors	
Input	MS3102A-18-10P
Output	MS3102A-18-10S

2.0 INSTALLATION

2.1 The Model 152A-1 Frequency Converter is designed for mounting in a standard 19 inch rack or cabinet. Refer to outline drawing 22096 for mounting dimensions. Provide support for the unit on both sides near the rear. Do not rely on the front panel alone to support the unit.

2.2 Electrical installation of the input and output is through connectors on the rear panel. Mating connectors for both input and output are supplied with the Frequency Converter.

2.2.1 Use mating connector part number MS3106A-18-10S to install input wiring. Connector pin assignments are:

PIN A	115VAC plus or minus 10%, 47-65Hz Input
PIN B	Input Common
PIN C	Chassis Ground

2.2.2 Use mating connector part number MS3102A-18-10P to install output wiring. Connector pin assignments are:

PIN A	115VAC, 400Hz Output
PIN B	Output Common
PIN C	Chassis Ground

NOTE

Input neutral, output neutral or both may be connected to chassis ground if desired.

3.0 OPERATION AND PERFORMANCE VERIFICATION

3.1 Initial Turn-On

3.1.1 Verify that all installation steps have been properly performed. Make sure that input and output connectors are tight and that there are no air flow obstructions at the top and rear of the Frequency Converter.

3.1.2 Check the 47-65~~VAC~~ Hz input voltage and verify that it is 115 volts plus or minus 10%.

NOTE

If the input voltage is above 132 volts or below 103 volts, the Frequency Converter will not turn on.

3.1.3 Connect a 0-150VAC voltmeter across the load terminals.

3.1.4 On the front panel of the Frequency Converte, set the input circuit breaker to the on, (up), position. The input power indicator lamp should be on immediately. After a time delay of approximately two seconds, the unit should be supplying 400Hz power to the load.

3.1.5 Observe the voltmeter connected across the load terminals. If the output voltage needs adjustment, refer to Section 5, ALIGNMENT PROCEDURES.

3.1.6 Verify that the cooling fan in the rear panel is turning.

3.1.7 Turn the Frequency Converter off by setting the front panel circuit breaker to the off, (down), position. The output voltmeter should have a zero indication, the input power indicator lamp should be off and the cooling fan in the rear panel should stop turning. Disconnect the AC voltmeter from the load terminals.

3.2 Routine Operation

3.2.1 For day-to-day operation, use the front panel circuit breaker to turn the Frequency Converter on and off as desired. Loads may be turned on and off remotely without turning the unit off each time.

3.2.2 Semiannual maintenance procedures are described in Section 6 of this manual. These procedures should be performed by a qualified technician.

4.0 THEORY OF OPERATION

4.1 Overall Schematic Analysis

4.1.1 The schematic diagram of the Model 152A-1 Frequency Converter is drawing 40213. Note that this drawing is a combination block and schematic diagram. In this section, the overall functions of the individual components and subassemblies are described. Detailed circuit analysis of the individual subassemblies is contained in the paragraphs that follow.

4.1.2 Input power connected at J1 is applied to the unit by closing circuit breaker CB1. With CB1 closed, voltage is applied to step-up autotransformer T1, auxiliary bias transformer T5, front panel indicator lamp DS1 and cooling fan B1.

4.1.2.1 The 195 volt output of autotransformer T1 is rectified by bridge rectifier CR1-CR4, which is an encapsulated four-terminal module. Filtering to obtain the main DC power for the inverter bus is by inductor L1 and capacitors C1-C2. Resistor R1 provides a discharge path for the capacitors when circuit breaker CB1 is opened. With the Frequency Converter operating at 115VAC input and no load connected to the output terminals, the voltage across the filter capacitors is approximately 210VDC. A 20 volt center-tapped winding on autotransformer T1, pins 4-5-6, provides power to low voltage power supply A1.

4.1.2.2 The secondary windings of auxiliary bias transformer T5 provide bias supplies for power modules A5-A6. When rectified by diodes CR17-CR24 and filtered by capacitors C8-C11, each bias supply voltage is approximately 2.5VDC as measured across the capacitors with the Frequency Converter operating.

4.1.3 Low voltage power supply A1 accepts input at 20 volts center-tapped at pins T-E-V. Outputs are +5 volts, -12 volts, a +5 volt delayed signal that appears approximately 2 seconds after circuit breaker CB1 is closed and a signal that controls logic and control module A2 in such a way that output voltage does not appear at full amplitude instantly, but has a "soft start" characteristic.

4.1.3.1 The 20 volt center-tapped supply is rectified by diodes on the printed circuit card. Due to space constraints with the printed circuit card cage, filter capacitors C4 and C5 are located off-card. C4 is

the filter capacitor for the 5 volt regulator input, while C4 is used to filter the -12 volt supply.

4.1.3.2 Integrated circuit IC1 is the +5V regulator for the logic supply. Input is at terminal B and must be at least 7 volts for the regulator to function properly. The +5V output is at terminal E, with the case of the regulator, terminal C, as common. Capacitors C6-C7 and C12-C14 are for noise reduction.

4.1.3.3 The low voltage power supply module has overvoltage and undervoltage cutout functions for protecting both the Frequency Converter and the connected loads. Both cutout functions sense the unregulated +12 volts at pin K, which varies with input voltage. If input is above 132VAC or below 98VAC while the Frequency Converter is operating, it will turn off. This is accomplished by removing the delayed +5 volt signal from pin A of driver modules A3-A4. Any condition that causes the delayed +5 volt signal to disappear will shut the unit off.

4.1.3.4 When input voltage falls below 132VAC following an overvoltage cutout, the unit will automatically restart. After an undervoltage cutout, however, the input must rise to 103VAC before the unit will restart. This hysteresis prevents on-off oscillations that might occur if the connected input power line is "soft". The hysteresis also requires that line voltage be at least 103VAC for the Frequency Converter to start up initially.

4.1.4 Logic and control module A2 contains a fixed frequency crystal controlled oscillator, "soft start" circuitry and circuits that regulate voltage and limit current. Voltage regulation is by means of feedback from transformer T1, whose secondary voltage at pins H and J of A2 with output set to 115VAC is approximately 34VAC. Current limit employs feedback from current transformer T4. With 4.5 amperes of load current, the feedback voltage at pins C and D of A2 and across resistors R2-R3 is approximately 39VAC. In the presence of an overload or short circuit condition in the output, the current limit circuits override voltage regulation. As load resistance decreases, voltage decreases proportionally so that current never exceeds 5 amperes. Output of the logic and control module at pins N and P is a pulse pattern in the form shown on drawing 20580.

4.1.5 Driver modules A3-A4 accept input from logic and control module A2 at pin S. These signals from pins N and P are the top two pulse trains shown on drawing 20580.

4.1.5.1 Each driver module splits the pulse train into tow drive signals, one for each of the two powr transistors on the power modules. One of the signals is inverted so that when one of the transistors is on, the other is off.

4.1.5.2 In order to make sure that the two power transistors are not on at the same time, the driver module introduces a delay between the two drive signals.

4.1.6 Output power modules A5-A6 form the inverter bridge. These modules each contain two transistors, an upper and a lower. To ensure rapid turn-off of each transistor, isolated bias supplies are provided by windings on transformer T5, diodes CR17-CR24 and capacitors C8-C11. Inductors L2 and L3 provide surge current protection. The diodes in parallel with the inductors provide a path for the inductor to discharge following each pulse.

4.1.7 The primary winding of transformer T2 is connected at the center points of the inverter bridge. These are the points where the emitters of the upper transistors are connected to the collectors of the lower transistors. Output filtering of the amplified pulse pattern is accomplished by the leakage inductance built into the transformer working with capacitor C3.

4.2 Subassembly Schematic Analysis

4.2.1 Low Voltage Power Supply Module A1

4.2.1.1 Refer to drawing 21013, the schematic diagram of the low voltage power supply module. Input voltage at 20 volts center-tapped is applied at pins T-E-V, rectified by diodes CR1-CR4 and filtered by capacitors C4 and C5 shown on drawing 40213. The unregulated -12VDC supply is at pin L and the +12VDC at pin K. All voltages are referenced to pins E and M, (common or logic ground). The +5 volt regulator, IC1 on drawing 40213, is connected at pins K-M-C. Pin C is at +5 volts with respect to pin M.

4.2.1.2 The overvoltage cutout function is at IC2 pins 8-9-14; undervoltage cutout is at IC2 pins 7-6-1. Potentiometers R3 and R6 set the overvoltage and undervoltage cutout points, respectively. A jumper

is connected between points X and Z on the P.C. card so that both functions use the regulated +5 volts as the adjustable reference.

4.2.1.3 Pins A and K of the module are strapped together externally, so both overvoltage and undervoltage functions sense the unregulated +12 volts at pin K. When the +12 volts, and therefore the input voltage, is in tolerance, both pins 1 and 14 of IC2 are high, permitting capacitor C7 to charge up. When C7 has charged to a voltage higher than the reference at IC2 pin 11, pin 13 goes low, turning transistor Q2 on and releasing the delayed +5 volts to the driver modules.

4.2.1.4 When input power is initially applied, IC2 pins 1 and 14 are high as stated above. This causes IC2 pin 2 to be low until capacitor C7 charges. This low output at pin 2 is the "soft start" signal to the logic and control module. When C7 has charges to complete the time delay, pin 2 of IC2 goes high to terminate the "soft start" signal.

4.2.1.5 When an overvoltage or undervoltage condition exists, either at turn-on or during operation, either pin 14 or pin 1 of IC2 goes low, removing the charge from capacitor C7. Transistor Q2 turns off, removing the delayed +5 volt signal from the driver modules and turning the Frequency Converter off. In the case of an overvoltage shutdown, the voltage on IC2 pin 8 need only decrease to the voltage on pin 9 to initiate another turn-on sequence. In the case of an undervoltage shutdown, however, resistor R12 creates a hysteresis such taht the input voltage to the Frequency Converter must rise five volts above the cut-out point before IC2 pin 1 goes high to restart the turn-on sequence.

4.2.2 Logic and Control Module A2

4.2.2.1 Refer to the schematic diagram of the logic and control module, drawing 40261B-1J. A voltage feedback signal from transformer T3, (drawing 40213), is connected at pins H and J. This signal is rectified by diodes CR2-CR6, then applied to pin 2 of IC1, an integrator amplifier. The rectified signal is then compared to a reference voltage on pin 3 which comes from IC9, a -5 volt regulator. The -5 volt regulator receives it's input from the -12 volt supply on the low voltage power supply module. Potentiometer R4 sets the output voltage from the Frequency Converter.

4.2.2.2 Voltage regulation is controlled by the voltage controlled oscillator, (VCO), at IC2 pins 4-5-12 and 7-9-10. When pin 1 of IC1 draws increased current through resistor R10, output voltage is reduced.

4.2.2.3 The "soft start" function of the logic and control module is controlled by transistor Q1. When power is applied to the Frequency Converter, pin F is low because of the output of the soft start comparator on the low voltage power supply. This signal turn Q1 on, applying a positive signal to pin 2 of IC1. This drives pin 1 extremely low, causing increased current in resistor R10, and output voltage is greatly reduced. When the delayed +5 volt signal from the low voltage power module, transistor Q2 cuts off. Capacitor C5 then discharges and pin 1 of IC1 begins to draw less current, allowing output voltage to rise to the preset amplitude.

4.2.2.4 Feedback for current limiting is from current transformer T4 on drawing 40213 and is connected at pins C and D of the logic and control module. In a manner similar to the voltage feedback, the current feedback signal is rectified and compared to the reference voltage from IC9. Potentiometer R8 adjusts the voltage at pin 6 of IC1. When the feedback signal is of sufficient amplitude, IC1 pin 7 draws current through resistor R11 to reduce voltage and limit current. Auctioneering diodes CR17 and CR18 ensure the amplifier calling for the least output from the Frequency Converter is in command.

4.2.2.5 Output frequency is set by the crystal controlled square wave oscillator at IC6, pins 10-11-13. The 230.4KHz output is divided by 3 in IC7, then applied to IC4 pin 1. The QD "divide by 16" output at pin 6 of IC4 is used to synchronize the VCO, (IC2), through IC6 pins 6-7-1. IC6 is a one-shot multivibrator that applies a one microsecond pulse to IC4B pin 12 through Schmitt triggers in IC10 and to the output of the VCO, (IC2 pin 12), through transistor Q2. The QD output frequency at IC4 pin 6 is 4800Hz and it's pulse width of 208.3 microseconds is equal to 30 electrical degrees at 400Hz. The VCO is reset every 30 electrical degrees.

4.2.2.6 The QD output at pin 6 of IC4 is also applied to "divide by 12" counter IC3 at pin 14. The four outputs of IC3 divide the 360 degrees of one cycle into twelve 30 degree steps. These signals are applied to PROM IC5 at inputs A4, A5, A6 and A7.

4.2.2.7 The VCO, (IC2 pins 4-5-12 and 9-10-7), is synchronized by the frequency control through transistor Q2 as described in paragraph 4.2.2.5 above. If the output of the Frequency Converter is at full voltage, (not in regulation), the VCO output is 15 pulses of 1 electrical degree every 15 electrical degrees. Voltage regulation is obtained by counting to 15 at a faster rate, stopping VCO operation, then resuming when the synchronizing signal is applied from transistor Q2. The 15 count is performed in PROM IC5 and appears as feedback from output 04 at pin 12 to pin 10 of IC2. When output 04 is low, the VCO stops operating until reset by the frequency control.

4.2.2.8 The VCO output is counted on IC4B and the zero to fifteen degree signals are applied to PROM IC5 at inputs A0, A1, A2 and A3. IC5 is programmed by the logic to generate waveshapes at outputs 01, 02 and 03 in the pattern shown on drawing 20580.

4.2.3 Driver Modules A3-A4

4.2.3.1 The schematic diagram of the driver modules is drawing 20199. Power for the modules is at pins A, (delayed +5 volts), pin M, (common), and pin K (-12 volts). These inputs are all from low voltage power supply module A1.

4.2.3.2 The pulse pattern input from the logic and control module is at pin S. This signal is split into two signals of opposite phase. That is, when one of the signals is high, the other is low. This is accomplished by HEX inverters IC1 and IC2. IC2 is a Schmitt trigger. The upper signal is routed through the components shown on the top half of the schematic and the lower signal through the components on the bottom half.

4.2.3.3 In order to ensure that two power transistors on a power module do not conduct simultaneously across the main inverter high voltage bus, a time delay is introduced between the upper and lower signals. In the upper channel, capacitor C6 and resistor R25 perform this function. The time delay between the two signals is 5 to 10 microseconds. The upper signal is amplified by Q4 and Q2, then applied to the upper transistor on the connected power module. The lower signal is amplified by Q8 and Q6, then applied to the lower transistor on the same power module.

4.2.3.4 To make sure that PNP transistors Q2 and Q6 turn off rapidly, both the upper and lower driver channels have "snap-off" circuits. The upper path is through capacitor C2 and transistors Q3 and Q1; the lower path is through C2, Q7 and Q5. There is no time delay in the "snap-off" signals. Each signal generates a positive base signal to it's respective PNP transistor that is from 10 to 18 microseconds in duration.

4.2.4 Power Modules A5-A6

4.2.4.1 Drawing 10538 is the schematic diagram of the power modules. Transistor Q1 is the upper transistor and Q2 is the lower. Two of these modules make up a single phase bridge.

4.2.4.2 Input signals from the driver are at pin T for the upper channel and at pin 2 for the lower channel. To ensure rapid turn-off of the power transistors, isolated bias supplies are connected at pins 5-9 and 3-8. See schematic diagram 40213.

4.2.4.3 Diodes CR1-CR2 provide a path for reverse currents caused by the inductance of the output transformer when a power transistor is turned off.

5.0 ALIGNMENT INSTRUCTIONS

WARNING

DANGEROUS VOLTAGES are present within the Frequency Converter when input power is connected. Observe all safety precautions to avoid LETHAL SHOCK.

CAUTION

DO NOT use or connect grounded electronic test equipment at any point inside the Frequency Converter when troubleshooting or making measurements.

5.1 Power Supply Module A1

5.1.1 Overvoltage Cutout Adjustment

5.1.1.1 Connect input power to the Frequency Converter through a single phase variac. Connect a 0-150VAC voltmeter across the input lines. Remove the P.C. card access cover.

5.1.1.2 With the input power circuit breaker off, raise input voltage to 115VAC. Set circuit breaker on. Observe normal start-up operation.

5.1.1.3 Slowly increase input voltage to 132VAC. On power supply module A1, adjust potentiometer R3 until the Frequency Converter turns off. Reduce input voltage to 115VAC and observe that the unit restarts.

5.1.2 Undervoltage Cutout Adjustment

5.1.2.1 With 115VAC input voltage and the Frequency Converter operating, slowly reduce input voltage to 98VAC. On the power supply module, adjust potentiometer R6 until the unit turns off. Increase input voltage to 115VAC and observe that the unit restarts.

NOTE

If the Frequency Converter turns off before the 98VAC input voltage is reached, increase input voltage until the unit restarts. Adjust potentiometer R6 one turn counterclockwise and attempt to reach 98VAC input. Continue doing this until the unit stays on at 98VAC, then perform the adjustment of paragraph 5.1.2.1.

5.1.2.2 Set the input power circuit breaker to off. Disconnect power at the source and remove the variac and voltmeter. Replace the P.C. card access panel and restore normal input and output connections.

5.2 Logic and Control Module A2

5.2.1 Output Voltage Adjustment

5.2.1.1 Remove the P.C. card access panel. Connect a 0-150VAC voltmeter across the normal load input terminals.

5.2.1.2 Set the input power circuit breaker on and observe the AC voltmeter. On the logic and control module, adjust potentiometer R4 for the desired output voltage. Set the input power circuit breaker off.

5.2.1.3 Disconnect the output AC voltmeter and replace the P.C. card access panel.

5.2.2 Output Current Limit Adjustment

5.2.2.1 Remove the P.C. card access panel. Disconnect normal loads from output connector J2.

5.2.2.2 Obtain a resistive dummy load of 25.5 ohms, 500 watts. DO NOT USE LIGHT BULBS. Connect the dummy load to J2 in place of the normal load. Connect a 0-150VAC voltmeter across the dummy load.

5.2.2.3 Set the input power circuit breaker to on and verify that output is at 115VAC. Observing the AC voltmeter, adjust potentiometer R8 on the logic and control module until output voltage just begins to reduce. This sets the current limiting point at 4.5 amperes.

5.2.2.4 Set the input power circuit breaker off. Remove the AC voltmeter and dummy load and reconnect normal load. Replace the P.C. card access panel.

6.0 TOOLS, TEST EQUIPMENT AND RECOMMENDED SPARES

6.1 List of Tools and Test Equipment

Oscilloscope, dual channel, double insulated.

Multimeter, 20,000 ohms/volt, Simpson Model 260 or equal, (2 each).

Ammeter, clip-on with 0-15 ampere scale.

Variable Autotransformer, Superior Electric Model 3PN116B or equal.

Dummy Load, resistive, 25.5 ohms, 500 watts, (fabricate locally).

Electronic Technicians' Tool Kit, TK-105 or equivalent.

Extender Card, Abacus Controls Inc. part number 20137.

Extender Card, Abacus Controls Inc. part number 20145.

Extender Card, Abacus Controls Inc. part number 20146.

Isolation Transformer, 120VAC to 20 volts center-tapped, 500Ma.

One pair input/output mating connectors for bench testing: (1) MS3106A-18-10S and (1) MS3106A-18-10P.

6.2 List of Recommended Spare Parts

The following spares list represents stockage requirements for maintaining one Model 152A-1 Frequency Converter for three years:

QTY	DESCRIPTION
2	Power Module, Abacus Controls Inc. part number 20798
2	Driver Module, Abacus Controls Inc. part number 20143-1
1	Logic and Control Module, Abacus Controls Inc. part number 40262B-1J

QTY	DESCRIPTION
1	Power Supply Module, Abacus Controls Inc. part number 21014
1	Rectifier Bridge, Motorola part number MDA3506
1	+5 Volt Regulator, part number 7805
1	AC Capacitor, 10uF, 330VAC
1	Fan, part number SU2A1
1	Capacitor, part number 36D202F250CC2A
1	Transformer, Abacus Controls Inc. part number M1343

7.0 MAINTENANCE, REPAIR AND CHECKOUT PROCEDURES

7.1 Routine Maintenance (Semiannual)

WARNING

Be sure that all power is removed from the Frequency Converter before proceeding.

7.1.1 Disconnect the mating connectors from J1 and J2 on the rear panel. Remove the Frequency Converter from it's rack mount. Place the unit on a bench and remove the P.C. card access panel from the rear. Remove the perforated top cover to gain access to all components and wiring.

7.1.2 Use a soft brush to loosen accumulated dirt and debris and remove with a vacuum cleaner. Take care not to break any solder connections. Wipe flat surfaces clean with a soft, dry cloth. If there are any oily or greasy deposits, remove them with a cloth moistened with a suitable solvent such as denatured alcohol. Take care not to remove markings.

CAUTION

The printed circuit modules are notched and keyed to prevent incorrect insertion. Note card positions carefully when removing them, as incorrect reinstallation can damage the edge connectors.

7.1.3 Remove the four printed circuit cards, taking care to note their positions in the card cage. Use a soft brush to remove dust and debris from the component side of each card. Clean the card edge connector fingers using a pencil eraser.

7.1.4 Use a soft brush to loosen any dust in the card edge connectors at the rear of the card cage. Remove dust with a vacuum cleaner. Replace four P.C. cards in the card cage. Take care to observe the notch/key feature. Be sure all cards are firmly seated.

7.1.5 Inspect all electrical connections for tightness and solder deterioration. Tighten any lugged terminations as needed.

7.1.6 Check all wiring for burned or cracket insulation. Make sure no wires are rubbing on sharp corners.

7.1.7 Inspect the fan mounted in the left rear. Remove dust from the blades and make sure the fan rotates freely without binding.

7.1.8 Replace the perforated top cover. Install the Frequency Converter in it's operating location and perform the procedure of paragraph 3.1, Initial Turn-On.

7.2 Corrective Maintenance

7.2.1 Corrective maintenance is defined as troubleshooting and repair to corrent a defect discovered during operation or performance verification. Table 7-11 contains typical faults, probable causes and corrective action for clearing faults.

7.2.2 The Troubleshooting Guide, Table 7-1, lists module or component replacements under corrective action. Instructions for making such replacements are contained in paragraph 7.3. Paragraph 7.4 describes post-repair checkout procedures that are designed to permit turn-on without further failures resulting from defective parts that were not found during troubleshooting.

WARNING

DANGEROUS VOLTAGES are present within the Frequency Converter when power is applied. Use extreme caution while troubleshooting.

CAUTION

DO NOT use or connect grounded electronic test equipment at any point while troubleshooting or making measurements. Since all internal circuitry is ungrounded and floating, failure to observe this precaution will result in massive damage.

7.2.3 Troubleshooting and repair procedures are most easily performed with the Frequency Converter on a work bench. For convenience in post-repair testing, input and output cables should be fabricated using the mating connectors called out in paragraph 6.1. Refer to paragraphs 2.2.1 and 2.2.2 for the mating connector pin assignments.

7.2.4 Reference designations of modules and components called out in Table 7-1 appear on schematic diagram 40213 and assembly drawing 42275. Refer to the schematic diagram for electrical connections and to

TABLE 7-1

TROUBLESHOOTING GUIDE, FREQUENCY CONVERTER MODEL 152A-1

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. No Output - circuit breaker trips	a. Shorted rectifier bridge CR1-CR4	Use an ohmmeter set to the Rx1 range to check each diode in the bridge. If defective, refer to para. 7.3.1 and replace. Perform the procedure of para. 7.4.
	b. Shorted capacitor C1-C2	Make sure there is no charge on C1-C2. Remove the jumper that connects C1(+) to C2(+). Use an ohmmeter set to the Rx1 range to check each capacitor. If either C1 or C2 is shorted, refer to para. 7.3.2 and replace. Perform the procedure of para. 7.4.
	c. Defective power modules A5-A6 NOTE: If either power module is found to be defective, also replace the corresponding driver module. A3 goes with A4 and A5 goes with A6.	Disconnect A5 and A6 by opening connectors P7-J7 and P8-J8. Refer to drawing 10538. Check all junctions of Q1 and Q2 with an ohmmeter set to the Rx1 range. Measure the resistance of R1 and R2. If any part is defective, refer to para. 7.3.3 and replace the module. Perform the procedure of para. 7.4.
	d. Shorted AC capacitor C3	Disconnect all wires from one terminal of C3. Use an ohmmeter set to the Rx1 range to check the capacitor. If shorted, refer to para. 7.3.4 and replace. Perform the procedure of para. 7.4.

TABLE 7-1

TROUBLESHOOTING GUIDE, FREQUENCY CONVERTER MODEL 152A-1

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
2. No Output - circuit breaker does not trip	a. Defective power supply module A1.	Replace A1 with a known good spare module. Perform the procedure of para. 7.4. If unsuccessful, go to the next step.
	b. Defective 5V regulator IC1	Remove one driver module and logic and control module A2. Install extender card P/N 20137 in power supply A1 slot. Install power supply in extender. Connect a multimeter set to 0-10VDC with (+) at pin C of the extender and (-) at pin M. Apply input power at 115VAC. If no +5 volt reading is present, refer to para. 7.3.5 and replace IC1. Perform the procedure of para. 7.4. If the +5 volts is present, perform the procedure of para. 5.1.
3. Output voltage is high or low and adjustment is ineffective	a. Defective logic and control module A2 or voltage feedback transformer T3	With power off, remove A2 from the card cage and insert extender P/N 20145. Install A2 in the extender. Connect a multimeter set for 0-50VAC at extender pins H and J. Apply power and read approximately 36VAC on the meter. If reading is zero, refer to para. 7.3.6 and replace T3. If reading is above 15VAC, replace A2 with a known good spare module. Perform the procedure of para. 7.4.

TABLE 7-1

TROUBLESHOOTING GUIDE, FREQUENCY CONVERTER MODEL 152A-1

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
4. Unit turns on, but output waveshape is badly distorted	a. Defective driver module A3 or A4 or logic and control module A2	With power off, remove driver A3 from the card cage and insert extender P/N 20146. Install A3 in the extender. Connect an oscilloscope with common at pin R of the extender and probe at pin S. Apply power and observe the pulse pattern shown on drawing 20580. There should be two pulses in the center of the long durations of the pulse train that are not shown on the drawing. If pattern is incorrect or missing, remove power and replace A2. If correct, probe the collectors of Q4 and Q8. Both waveshapes should be amplified pulse patterns with additional pulses or overshoots on each leading edge. Remove power and replace A3 if defective. Perform the procedure of para. 7.4. If A3 tests good, repeat the above procedure substituting driver A4 for A3.
5. Unit overheats during operation	a. Defective cooling fan B1.	If fan B1 is not turning with power applied, refer to para. 7.3.6 and replace.
	b. Air inlet screen blocked	Remove all obstructions to air flow.

the assembly drawing for parts locations. The bubble callouts on the assembly drawing correspond to the find number on the main parts list.

7.3 Repair Procedures

7.3.1 Replace Rectifier Bridge CR1-CR4

7.3.1.1 Unsolder the four leads from the rectifier bridge, taking care not to burn the wire insulation. Mark the AC leads and the (+) and (-) leads.

7.3.1.2 Loosen and remove the nut, flat washer and lockwasher from the center hole of the bridge. Remove the defective bridge and install a new one, using a small amount of thermal compound on the mounting surface. Install the nut, flat washer and lockwasher and tighten snuggly.

7.3.1.3 Solder the AC leads and the (+) and (-) leads to the terminals on the bridge that are so marked. Remove soldering flux using a suitable solvent such as denatured alcohol or trichlorethane.

7.3.1.4 Perform the procedure of paragraph 7.4.

7.3.2 Replace Capacitor C1 or C2.

7.3.2.1 Loosen and remove the two screws and internal tooth lockwashers that secure the (+) and (-) wires to the capacitor.

7.3.2.2 Loosen, but do not remove, two of the three screws, lockwashers, flat washers and nuts that fasten the capacitor bracket to the side wall of the chasis. Loosen, but do not remove, the tangent screw that tightens the band of the clamp around the capacitor. Remove the defective capacitor.

7.3.2.3 Inspect the inside of the capacitor clamp band for any burrs that might puncture the plastic insulation on the replacement capacitor. Smooth the clamping surface with a file or emery cloth.

7.3.2.4 Install the new capacitor, orienting the terminals, (+ and -), in the same way as the second capacitor. Tighten the tangent screw snuggly, but do not overtighten. Tighten the two screws that fasten the capacitor clamp to the wall of the chassis.

7.3.2.5 Install the wires removed in 7.3.2.1, being carefull to observe correct polarity. Tighten the two screw terminals snuggly. Do not overtighten as the aluminum threads will strip if too much torque is applied.

7.3.2.6 Perform the procedure of paragraph 7.4.

7.3.3 Replace Power Module A5 or A6

7.3.3.1 Open the floating connector, (P7-J7 or P8-J8), to disconnect the defective module from the wiring harness.

7.3.3.2 Loosen and remove the four screws, flat washers and lockwashers that fasten the power module to the mounting spacers. Remove the module.

7.3.3.3 Install a new power module and tighten the mounting hardware snuggly. Reconnect the floating connector, (P7-J7 or P8-J8).

7.3.3.4 Perform the procedure of paragraph 7.4.

7.3.4 Replace AC Capacitor C3

7.3.4.1 Remove the wires from both terminals of the capacitor. If connector clips are installed, merely slide them off the terminals. If the wires are soldered to the terminals, take care not to burn the wire insulation when unsoldering.

7.3.4.2 Loosen, but do not remove, two of the three screws, lockwashers, flat washers and nuts that fasten the capacitor clamp to the wall of the chassis. Loosen, but do not remove, the tangent screw that tightens the band of the clamp around the capacitor. Remove the defective capacitor.

7.3.4.3 Install the new capacitor. Tighten the tangent screw snuggly. Tighten the two screws that fasten the clamp to the wall of the chassis.

7.3.4.4 Restore the wire connections to the capacitor terminals. If the connections are soldered, remove all flux using a suitable solvent.

7.3.4.5 Perform the procedure of paragraph 7.4.

7.3.5 Replace +5 Volt Regulator IC1

7.3.5.1 Loosen and remove the two screws that fasten IC1 to it's socket and mounting bracket. Pull the regulator out of it's socket, taking care not to damage the insulator or socket.

7.3.5.2 Inspect the insulator for any punctures or cuts and replace if damaged. Make sure that the bracket, both sides of the insulator and the case of the replacement regulator are clean.

7.3.5.3 Push the new regulator and insulator into the socket. Be sure the socket is properly seated in the bracket holes. Install and tighten the two mounting screws. Do not overtighten, as the insulator may be punctured.

7.3.5.4 Use an ohmmeter set to the Rx10K scale to check insulation resistance between the case of the regulator and the chassis. Read 10 megohms, minimum.

7.3.5.5 Perform the procedures of paragraph 7.4 and paragraph 5.1.

7.3.6 Replace Fan B1

7.3.6.1 With all power removed, unsolder the two fan power leads from the standoffs on the left wall of the chassis. Remove the rear power module if necessary to gain sufficient work space.

7.3.6.2 Loosen and remove the four screws and other hardware that fastens the fan and screen to the rear panel. Remove the defective fan.

7.3.6.3 Install the replacement fan and the screen using the original mounting hardware. Be sure the fan blades rotate freely. Tighten the mounting hardware snuggly.

7.3.6.4 Press the two fan power wires to the two standoffs. Cut, strip and tin the wires and solder them to the standoffs.

7.4 Post-Repair Checkout and Performance Verification

7.4.1 Ground Clearance Test

Following any repair, use an ohmmeter set to the Rx10K range and check the following points for a minimum of one megohm to chassis ground:

CB1, all four terminals.
C1, (+) and (-) terminals.
Transistors on power modules (case to ground).
Output pins J2-A and J2-B.

7.4.2 After checking for ground clearance, connect input power to J1 through a single phase variac. Set variac for zero output.

7.4.3 Modify extender card part number 20137 as follows:

7.4.3.1 Approximately one inch below the top connector, cut the foils that go to pins T and V. Remove one-eighth inch of foil from each trace.

7.4.3.2 Connect a source of 20 volts center-tapped to pins T, E and V with the center-tap at pin E. Solder wires to the turret terminals. Practically any isolation transformer with a center-tapped secondary may be used with a small variac in the primary to adjust the output to 20VCT.

NOTE

The purpose of modifying the extender card as described above is to permit operation of the low voltage control circuits without applying power to the inverter bridge. With the control circuits operational, the main input power may be increased slowly so as to detect defective parts that were overlooked in troubleshooting without causing a catastrophic failure.

7.4.4 Slow Turn-On Procedure

7.4.4.1 Insert the modified extender card in the low voltage power supply slot. Install the power supply in the extender's connector.

7.4.4.2 Connect an AC voltmeter across J1-A and J1-B. Connect a second AC voltmeter across J2-A and J2-B. Set both meters to the 0-150VAC range. Install a clip-on ammeter set for 0-15 amperes on one of the input power leads. Connect an oscilloscope across the output terminals.

7.4.4.2 Energize the 20VCT supply to the power supply module. With the input variac set for zero output, set the circuit breaker on the front panel of the Frequency Converter to the on, (up), position.

7.4.4.3 Monitor input current and output voltage and waveshape. Slowly increase input voltage. If input current exceeds 10 amperes at any time, there are defective parts still in the unit. Reduce input to zero, deenergize the 20VCT supply and continue troubleshooting if input current is excessive.

7.4.4.4 If input current remains below 10 amperes, continue raising input voltage. The output waveshape may be somewhat distorted, but should be symmetrical. When input is at 100VAC, adjust potentiometer R4 on logic and control module A2 for the desired output voltage.

7.4.4.5 Continue raising input until 115VAC is reached. Allow the unit to operate in this configuration for ten minutes. Slowly reduce input voltage to zero and deenergize the 20VCT supply. Set the input circuit breaker to the off, (down), position.

7.4.4.6 Remove the variac from the input lines and connect J1 directly to the 115VAC supply. Remove the modified extender and install the low voltage power supply directly into it's slot.

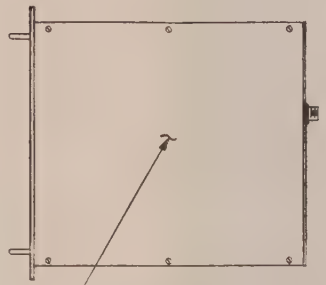
7.4.4.7 Set the input circuit breaker to the on position and observe normal start-up and operation.

7.4.4.8 Verify all of the adjustments described in paragraph 5.0.

8.0 DRAWINGS AND PARTS LISTS

Number	Description
22096	Outline Drawing, Model 152A-1 Frequency Converter
40213	Schematic Diagram, Model 152A-1 Frequency Converter
21013	Schematic Diagram, Low Voltage Power Supply Module A1
40261B-1J	Schematic Diagram, Logic and Control Module A2
20199	Schematic Diagram, Driver Modules A3-A4
10538	Schematic Diagram, Power Modules A5-A6
P/L 152A-1	Parts List, Model 152A-1 Frequency Converter
42275	Assembly Drawing, Model 152A-1 Frequency Converter
P/L 21014	Parts List, Low Voltage Power Supply A1
21014	Assembly Drawing, Low Voltage Power Supply Module A1
P/L 40262B-1J	Parts List, Logic and Control Module A2
40262B-1J	Assembly Drawing, Logic and Control Module A2
P/L 20143-1	Parts List, Driver Modules A3-A4
20143-1	Assembly Drawing, Driver Modules A3-A4
P/L 20798	Parts List, Power Modules A5-A6
20798	Assembly Drawing, Power Modules A5-A6

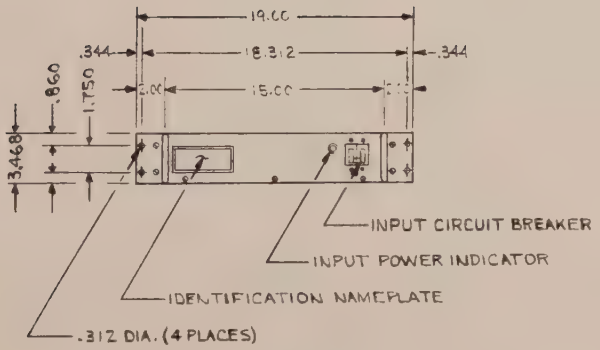
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL



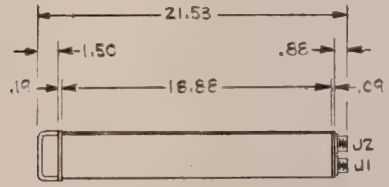
TOP VIEW

J1 MATE-P1, MS3106A-18-10S
CONNECTIONS:
PIN A, PIN B } 115VAC±10%, 47-63Hz
PIN C - CHASSIS GND.

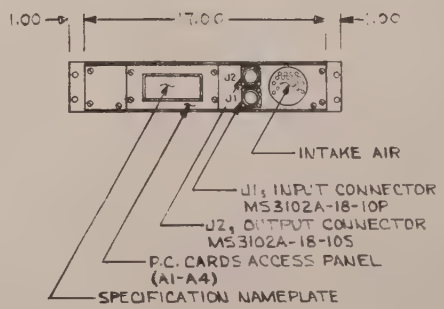
J2 MATE-P2, MS3106A-18-10P
CONNECTIONS:
PIN A, PIN B } 100-130VAC, 400Hz, 500VA
PIN C - CHASSIS GND.



FRONT VIEW



R.H. SIDE VIEW



REAR VIEW

SCHEM.- 40213	7755
ASSY.- 42275	7755
NEXT ASSY.	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/64 | DECIMALS 3PLC ±.015, 2PLC ±.03 | ANGLES ±1/2°

MATERIAL N/A

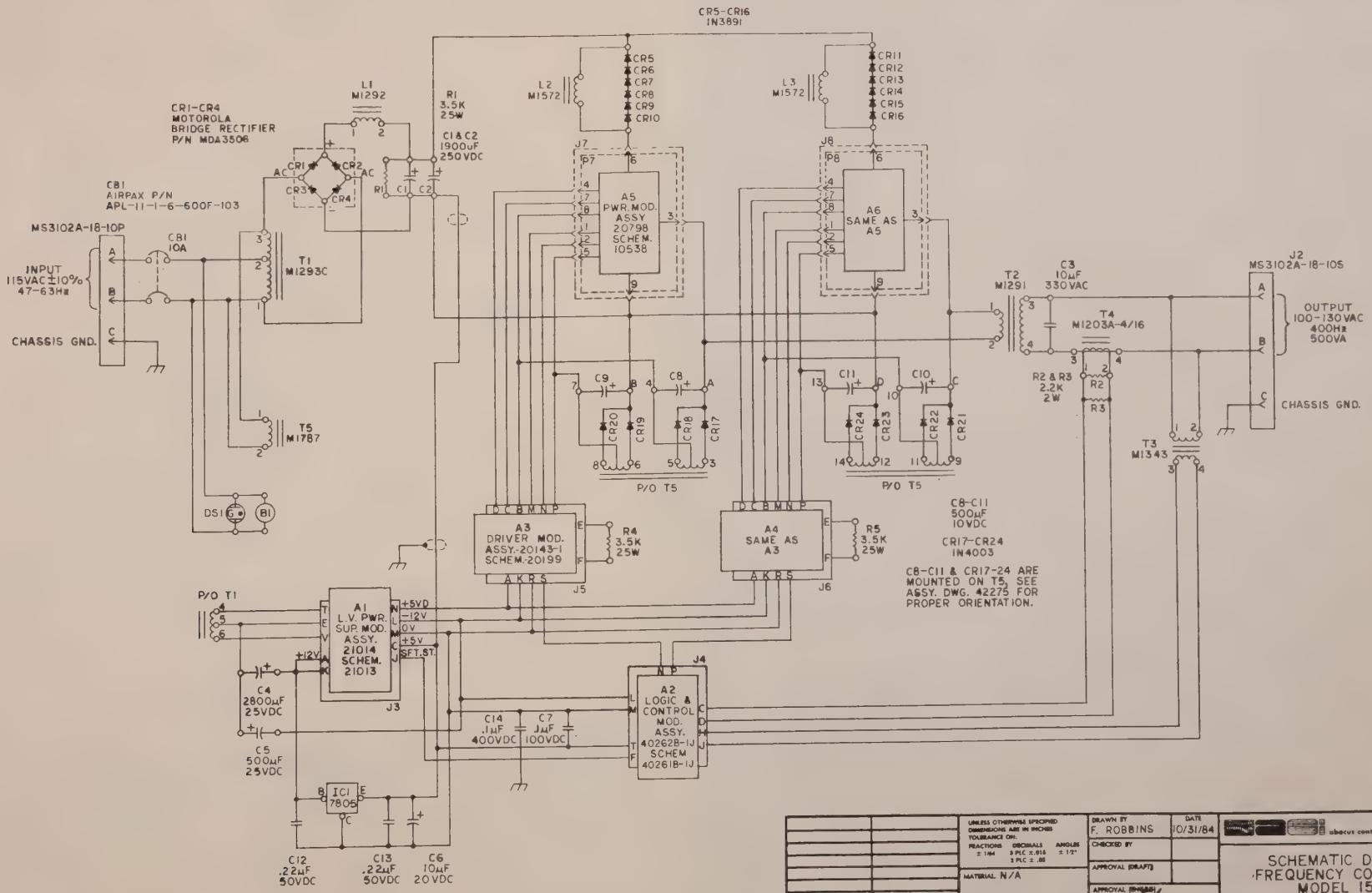
FINISH N/A

DRAWN	F. ROBBINS	11/6/84
CHECKED		
APPROVED	R.J. Card	11/6/84
APPROVED		

abacus controls inc.
80 READINGTON ROAD
P.O. BOX 883
SOMERVILLE, N.J.
08876-0883

OUTLINE DRAWING FREQUENCY CONVERTER MODEL 152A-1

SIZE		
B	54241	22096
SCALE 1 : 8		SHEET 1 OF 1



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
ALL	K	COMPLETELY REDRAWN	10/31/84	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE ON:
FRACTIONS ± 1/64 DECIMALS 3 PLC ± .016 2 PLC ± .03 ANGLES ± 1/2°
MATERIAL N/A
FINISH: N/A

ASSY-42275	7755
NEXT ASSY	USED ON
APPLICATION	

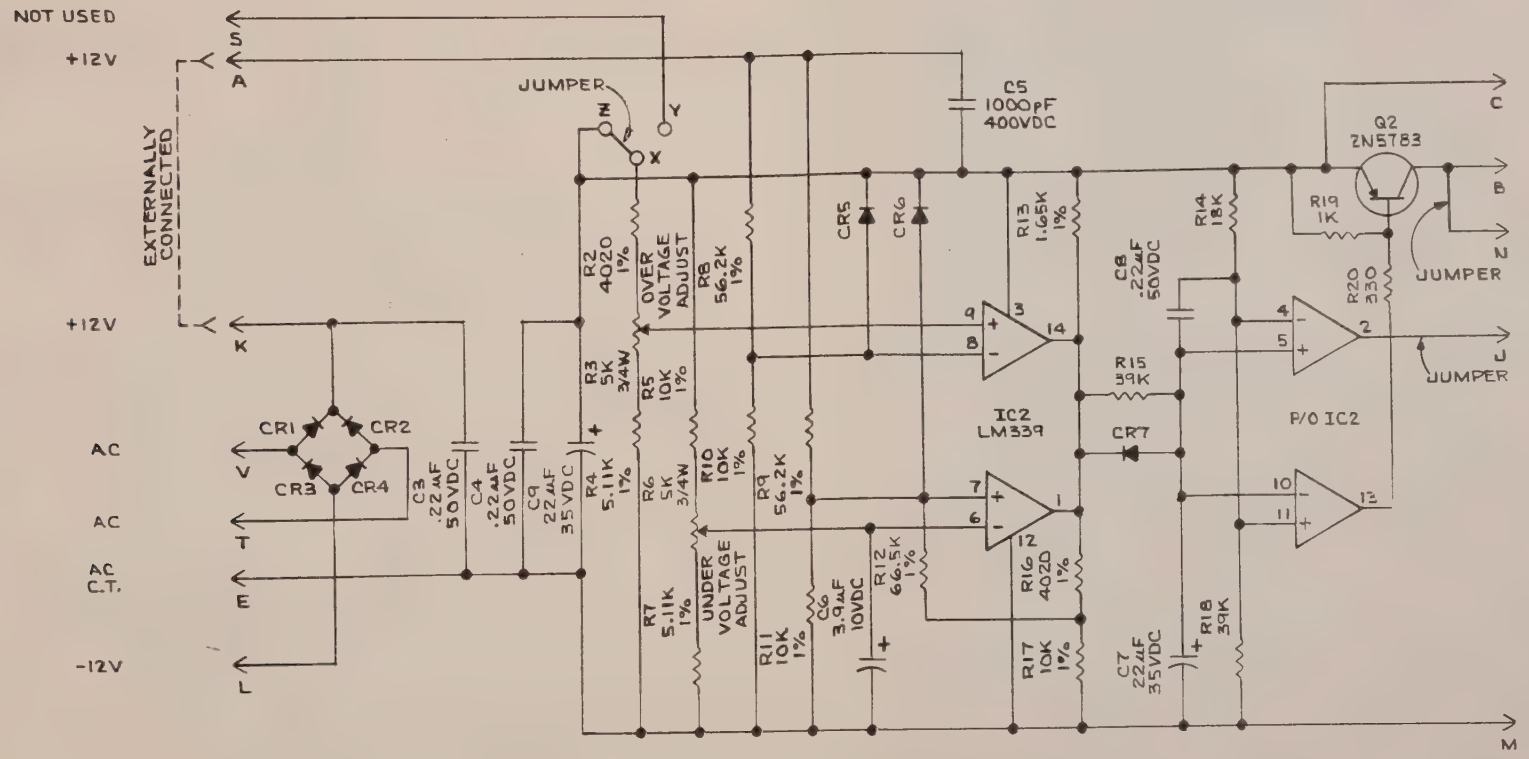
DRAWN BY F. ROBBINS — DATE 10/31/84
CHECKED BY
APPROVAL (DRAFT)
APPROVAL (ENGR)
APPROVAL (MGMT)

abacus controls inc

SCHEMATIC DIAGRAM FREQUENCY CONVERTER MODEL 152A-1

54241	SIZE D	40213
SCALE NONE		SHEET OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
E	COMPLETELY REDRAWN	11/9/84	



NOTES:

1. ALL DIODES (CR1-CR7) ARE IN4003.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED.
3. C1, C2, IC1, Q1 & R1 ARE NOT USED IN THIS CONFIGURATION.

	7755
21014	21
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± 1/64 | DECIMALS 3PLC ± .015, 2PLC ± .03 | ANGLES ±1/2°

MATERIAL N/A

FINISH N/A

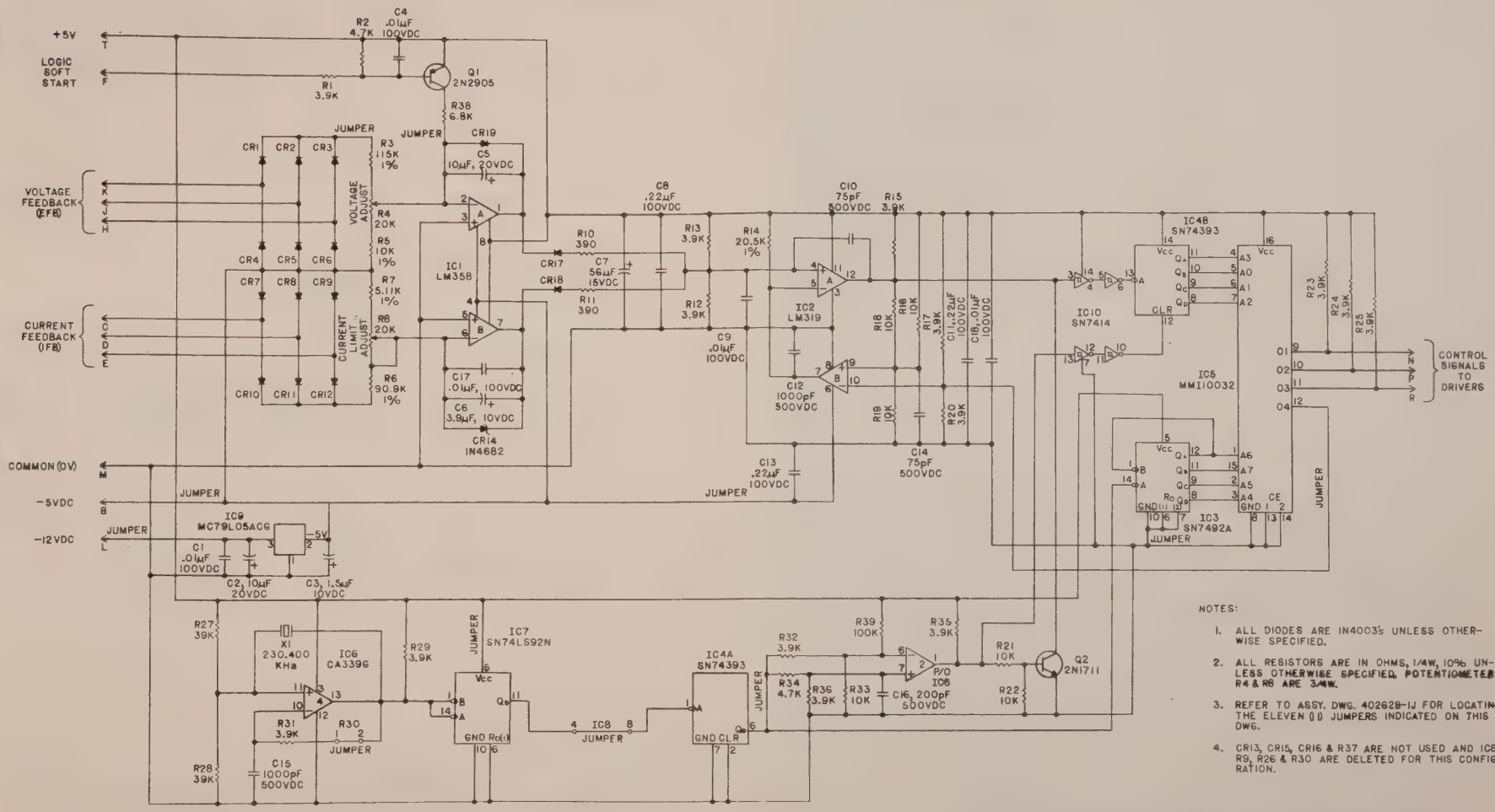
DRAWN	F. ROBBINS	11/9/84
CHECKED		
APPROVED	R Robbins	11/9/84
APPROVED		

abacus controls inc.
80 READINGTON ROAD
P.O. BOX 893
SOMERVILLE, N.J.
08876-0893

SCHEMATIC DIAGRAM
LOW VOLTAGE POWER SUPPLY MODULE
P.C. CARD

SIZE		
B	54241	21013

SCALE NONE | SHEET 1 OF 1



NOTES:

1. ALL DIODES ARE IN4003's UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED. POTENTIOMETERS R4 & R8 ARE 3/4W.
3. REFER TO ASSY. DWG. 40262B-1J FOR LOCATING THE ELEVEN (11) JUMPERS INDICATED ON THIS DWG.
4. CR13, CR15, CR16 & R37 ARE NOT USED AND IC8, R9, R26 & R30 ARE DELETED FOR THIS CONFIGURATION.

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED

	7755
	6657
40262B-1J	21
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE ON:
FRACTIONS ± 1/64 DECIMALS 3 PLC ± .010 2 PLC ± .03 ANGLES ± 1/2°
MATERIAL: N/A
FINISH: N/A

DRAWN BY: F. ROBBINS
DATE: 11/12/84
CHECKED BY:
APPROVAL (DRAFT):
APPROVAL (ENGR): M.P. Ford 11/13/84
APPROVAL (QUALITY):

abacus controls inc

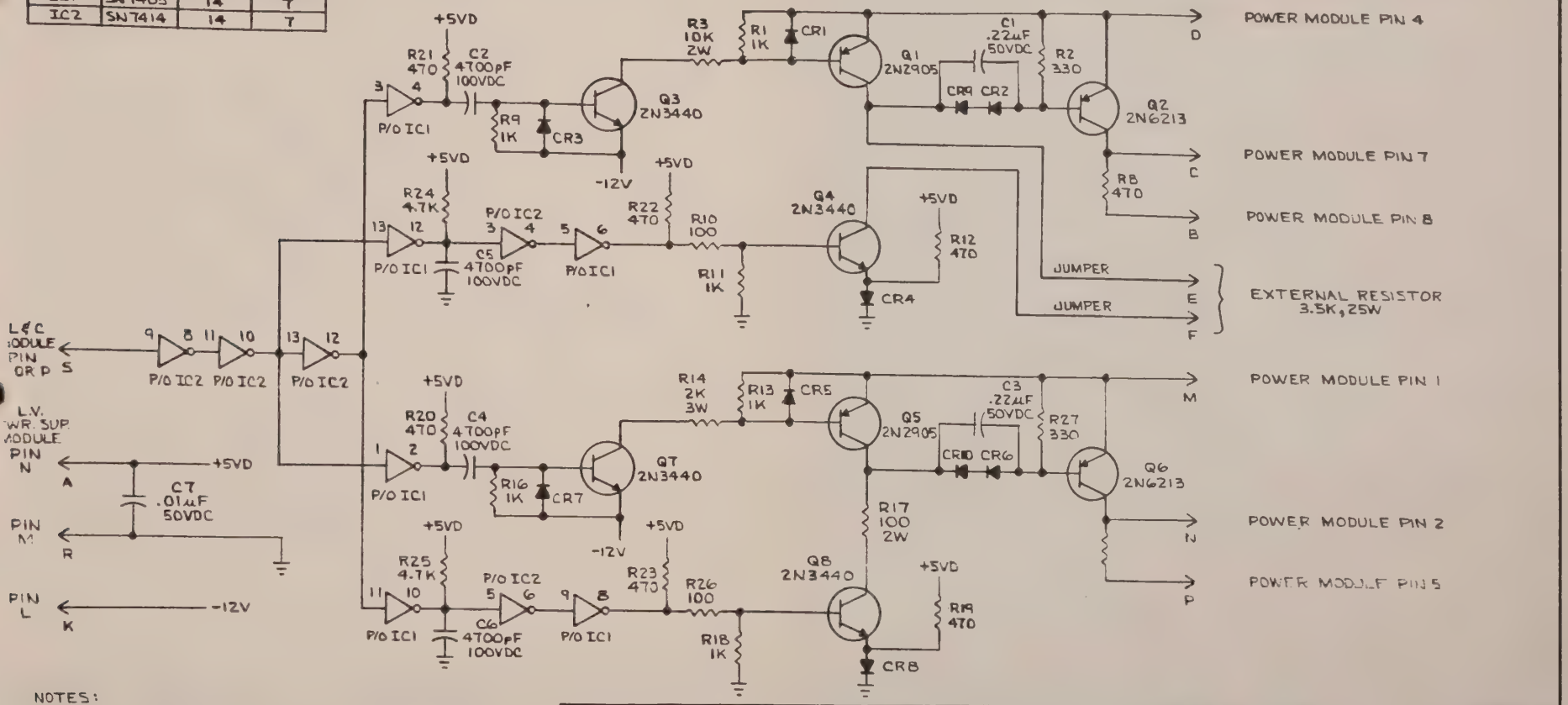
SCHEMATIC DIAGRAM
LOGIC & CONTROL MODULE
P.C. CARD

54241	SIZE D	40261B-1J

SCALE NONE SHEET OF

IC DATA			
IC DESIG.	TYPE	SUPPLY PINOUT Vcc	GND
IC1	SN7405	14	7
IC2	SN7414	14	7

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
F	COMPLETELY REDRAWN	11/7/84	RTC



NOTES:

1. ALL DIODES (CR1-CR10) ARE IN4003.
2. ALL RESISTORS ARE IN OHMS, 1/4 W, 10% UNLESS OTHERWISE SPECIFIED.
3. R4, R5, R6 & R7 ARE NOT USED IN THIS CONFIGURATION.

	7755
20143-1	21
NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± 1/64, DECIMALS .XX ± .03, .XXX ± .03, ANGLES ±1°
MATERIAL N/A
FINISH N/A

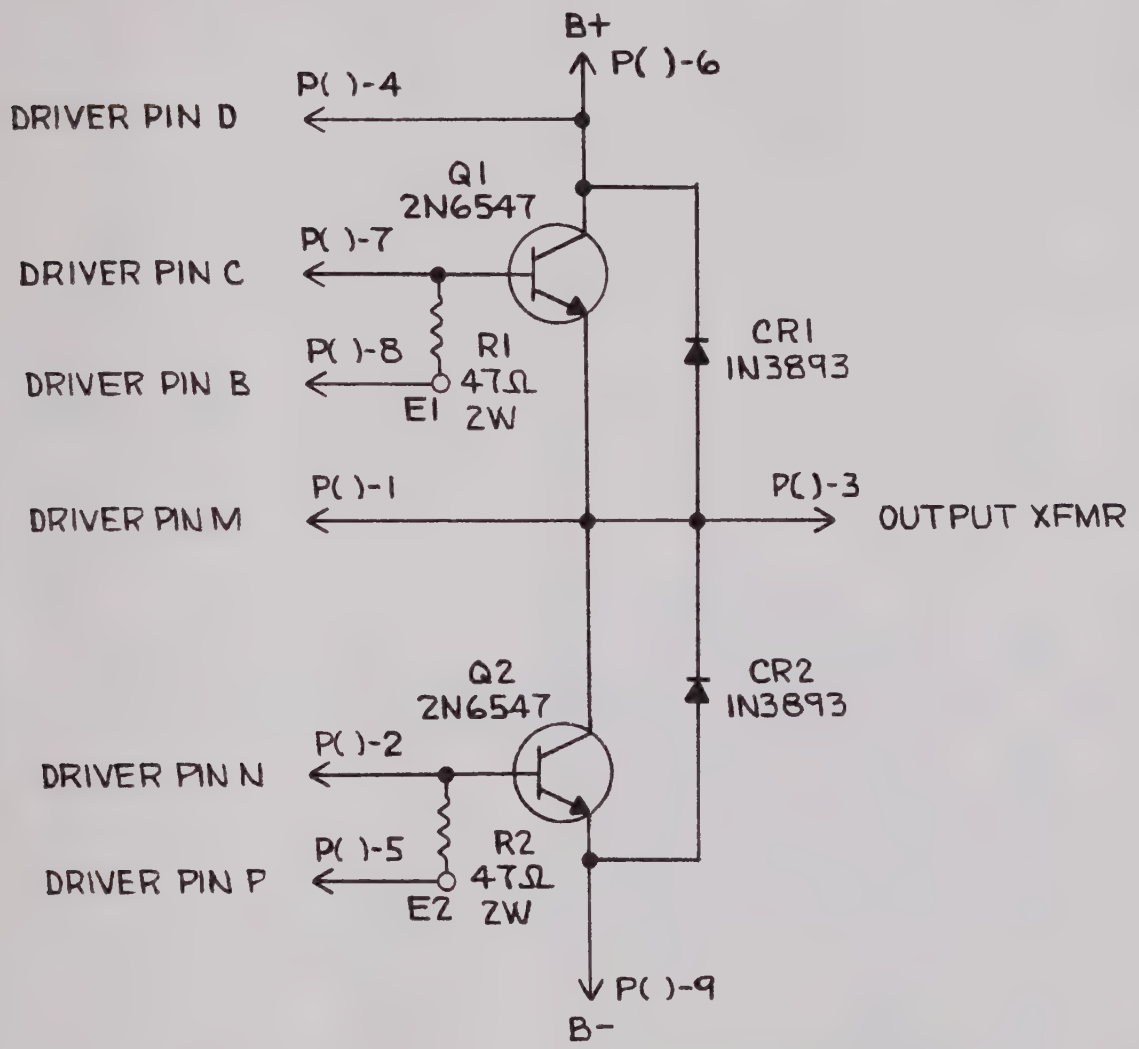
DRAWN F. ROBBINS 11/7/84
CHECKED
APPROVED RTC Tom 11/7/84
APPROVED

abacus controls inc
80 READINGTON ROAD
P O BOX 893
SOMERVILLE, NJ
08876-0893

SCHEMATIC DIAGRAM DRIVER MODULE P.C. CARD

SIZE B | 54241 | 20199

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
20798	7755	C	COMPLETELY REDRAWN – NO CHANGES.	11/6/84	RB



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64, DECIMALS 3 PLC ± .015, 2 PLC ± .03, ANGLES ± 1/2°	CONTRACT NO.	abacus controls inc. 80 READINGTON ROAD SOMERVILLE, N. J. 08876
MATERIAL N/A	DRAWN F. ROBBINS 11/6/84	SCHEMATIC DIAGRAM POWER MODULE 20798
	CHECKED	
FINISH N/A	ENGINEER RB 11/8/84	SIZE A 54241 10538
	APPROVAL	SCALE NONE SHEET 1 OF 1

TITLE MAIN PARTS LIST
PL 152A-1

abacus controls inc.

DATE 11/20/84 REV
SHEET 1 OF 5

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
		Schematic		ACI	54241	40213, Rev. K	
		Assembly		ACI	54241	42275	
		Technical Manual		ACI	54241	10783	
		Outline Drawing		ACI	54241	22096	
	A1	L.V. Power Supply Module		ACI	54241	21014	1
	A2	Logic & Control Module		ACI	54241	40262-1J	1
	A3-4	Driver Module		ACI	54241	20143-1	2
	A5-6	Power Module		ACI	54241	20798	2
	B1	Fan	115VAC,50/60Hz	Rotron	23936	028267, Model SU2A1	1
	C1-2	Capacitor, Elec.	1900uF,250VDC	Sprague	56289	36D202F250CC2A	2
	C3	Capacitor, Oil	10uF,330VAC	Mallory	37942	21FD3310PTD	1
	C4	Capacitor, Elec.	2800uF,25VDC	National	58377	85CX2820025GJ4	1
	C5	Capacitor, Elec.	500uF,25VDC	National	58377	85CX501U025EW4	1
	C6	Capacitor, Tant.	10uF,20VDC	Kemet	31433	T110B106K020AS	1
	C7	Capacitor, Ceramic	.1uF,100VDC	QPL	81349	CK06BX104K	1
	C8-11	Capacitor, Elec.	500uF,10VDC	National	58377	85CX500V010XV4	4
	C12-	Capacitor, Ceramic	.22uF,50VDC	QPL	81349	CK06BX224K	2
	C13						
	C14	Capacitor, Ceramic	.1uF,400VDC	CDE	14655	WMF4P1	1
	CB1	Circuit Breaker	10A,2 Pole	Airpax	81541	APL-11-1-600F-103	1
	CR1-4	Rectifier, Bridge	400V,25A	Motorola		MDA3506	1

TITLE MAIN PARTS LIST
PL 152A-1

abacus controls inc.

DATE 11/20/84 REV
SHEET 2 OF 5

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	CR5-16	Diode, High Speed		QPL	81349	1N3891	12
	CR17-	Diode		QPL	81349	1N4003	8
	CR24						
	DS1	Lamp	Green,125VAC	IDI	91802	1052QA5	1
	IC1	Integrated Circuit,Volt. Reg.+5VDC		QPL	81349	7805 (TO-3 Package)	1
	J1	Connector, Input		QPL	81349	MS3102A-18-10P	1
	J2	Connector, Output		QPL	81349	MS3102A-18-10S	1
	J3-6	Connector, P.C. Card		Amphenol	02660	143-018-01	4
	J7-8	Connector, Cable		Molex	87504	03-09-1091	2
	L1	Choke, Input		ACI	54241	M1292 *(SCD #21567)	1
	L2-3	Choke, Surge		ACI	54241	M1572 *(SCD #21568)	2
	P1	Connector, Input	(J1 Mate)	QPL	81349	MS3106A-18-10S	1
	P2	Connector, Output	(J2 Mate)	QPL	81349	MS3106A-18-10P	
	P7-8	Connector, Cable	P/O A5,A6				
	R1	Resistor,Fxd,WW	3.5K,25W,10%	Ohmite	44655	0210	3
	R2-3	Resistor,Fxd,Comp.	2.2K,2W,10%	AB	81349	RC42GF222K	2
	R4-5	S/A R1					
	T1	Transformer, Input		ACI	54241	M1293C *(SCD #21569)	1
	T2	Transformer, Output		ACI	54241	M1291	1

TITLE MAIN PARTS LIST
PL 152A-1

abacus controls inc.

DATE 11/20/84 REV
SHEET 3 OF 5

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	T3	Transformer, EFB		ACI	54241	M1343	1
	T4	Transformer, IFB		ACI	54241	M1203A-4/16	1
	T5	Transformer, Bias		ACI	54241	M1787 *(SCD #21573)	1
		MISCELLANEOUS SPECIAL ASSEMBLY ITEMS					
01		Guides, P.C. Card	(A1-4)	Ckt. Struc.	21355	88055-3	8
02		Standoff,5/16 Hex x 5/8	(A5-6 Mtg.)	Amatom	06540	8396-A-0632-17	8
03		Standoff,Insul. Turret	(B1,C4-5)	CTC	71279	3650-1	6
04		Bracket,Capacitor	(C3)	Mallory	37942	VR6	1
05		Bracket,Capacitor	(C1-2)	Mallory	37942	VR10	2
06		Terminal Lug,Solder	(CR5-16)	Zierick	79963	520	12
07		Insulator,DO-4 Diode	(CR5-16)	Bergquist	55285	7403-09FR-22	12
08		Washer,Nylon Shoulder	(CR5-16)	H.H. Smith	83330	2666	12
09		Nut,Tinnerman	(DS1)	IDI	91802	SN0461	1
10		Insulator,TO-3	(IC1)	Bergquist	55285	7403-09FR-04	1
11	XIC1	Socket,Power Transistor	(IC1)	R. Nugent	06776	MP-3452-T	1
12		Terminal Lug,Solder	(J3-4)	H.H. Smith	83330	1410-10	1
13		Key,P.C. Card Connector	(J3-6)	Amphenol	02660	143-953	4
14		Terminal,Female	(J7-8)	Molex	87504	02-09-1103	18
15		Not Used					
16		Bracket,Mtg.	(R1,R4-5)	Ohmite	44655	9	3 pr.
17		Handle,5/160.D.x3",Brass Nickel Pl		H.H. Smith	83330	2057	2
18		Nameplate,Identification		ACI	54241	10346-2	1
19		Nameplate,Specification		ACI	54241	11266	1

TITLE MAIN PARTS LIST
PL 152A-1

abacus controls inc.

DATE 11/20/84 REV
SHEET 3 OF 5

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	T3	Transformer, EFB		ACI	54241	M1343	1
	T4	Transformer, IFB		ACI	54241	M1203A-4/16	1
	T5	Transformer, Bias		ACI	54241	M1787 *(SCD #21573)	1
		MISCELLANEOUS SPECIAL ASSEMBLY ITEMS					
01		Guides, P.C. Card	(A1-4)	Ckt. Struc.	21355	88055-3	8
02		Standoff,5/16 Hex x 5/8	(A5-6 Mtg.)	Amatom	06540	8396-A-0632-17	8
03		Standoff,Insul. Turret	(B1,C4-5)	CTC	71279	3650-1	6
04		Bracket,Capacitor	(C3)	Mallory	37942	VR6	1
05		Bracket,Capacitor	(C1-2)	Mallory	37942	VR10	2
06		Terminal Lug,Solder	(CR5-16)	Zierick	79963	520	12
07		Insulator,DO-4 Diode	(CR5-16)	Bergquist	55285	7403-09FR-22	12
08		Washer,Nylon Shoulder	(CR5-16)	H.H. Smith	83330	2666	12
09		Nut,Tinnerman	(DS1)	IDI	91802	SN0461	1
10		Insulator,TO-3	(IC1)	Bergquist	55285	7403-09FR-04	1
11	XIC1	Socket,Power Transistor	(IC1)	R. Nugent	06776	MP-3452-T	1
12		Terminal Lug,Solder	(J3-4)	H.H. Smith	83330	1410-10	1
13		Key,P.C. Card Connector	(J3-6)	Amphenol	02660	143-953	4
14		Terminal,Female	(J7-8)	Molex	87504	02-09-1103	18
15		Not Used					
16		Bracket,Mtg.	(R1,R4-5)	Ohmite	44655	9	3 pr.
17		Handle,5/160.D.x3",Brass Nickel Pl		H.H. Smith	83330	2057	2
18		Nameplate,Identification		ACI	54241	10346-2	1
19		Nameplate,Specification		ACI	54241	11266	1

TITLE MAIN PARTS LIST
PL 152A-1

abacus controls inc.

DATE 11/20/84 REV
SHEET 4 OF 5

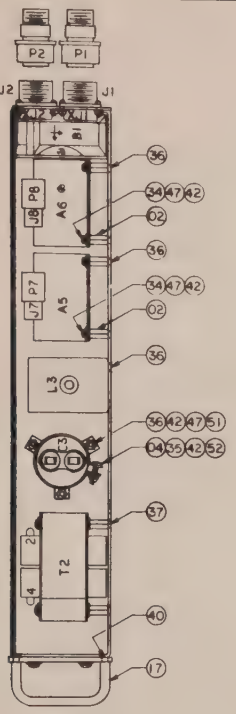
FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
		SHEET METAL					
20		Chassis		ACI	54241	50004G	1
21		Front Panel		ACI	54241	40062	1
22		Card Cage		ACI	54241	40441	1
23		Blower Screen		ACI	54241	20096	1
24		Rear Panel		ACI	54241	20131B	1
25		Rear Plate		ACI	54241	10108	1
26		Access Plate,P.C. Cards		ACI	54241	20092	1
27		Top Cover		ACI	54241	40440	1
28		Bracket,Surge Diodes (CR5-16)		ACI	54241	10490	1
29		Bracket,Power Transistor(TO-3)(IC1)		ACI	54241	10970	1
30		Not Used					
		GENERAL HARDWARE					
31		4-40x1/4 PHMS,SS		QPL	81349	MS51957-13	20
32		4-40x1/2 PHMS,SS		QPL	81349	MS51957-17	16
33		4-40x1/4 FHMS,SS		QPL	81349	MS51959-13	2
34		6-32x3/8 PHMS,SS		QPL	81349	MS51957-28	16
35		6-32x5/8 PHMS,SS		QPL	81349	MS51957-31	9
36		6-32x3/8 FHMS,SS		QPL	81349	MS51959-28	53
37		8-32x3/8 FHMS,SS		QPL	81349	MS51959-43	12
38		8-32x3/4 FHMS,SS		QPL	81349	MS51959-48	1
38		10-32x1/2 PHMS,SS		QPL	81349	MS51958-63	13
40		10-32x1/2 FHMS,SS		QPL	81349	MS51960-64	4

TITLE MAIN PARTS LIST
PL 152A-1

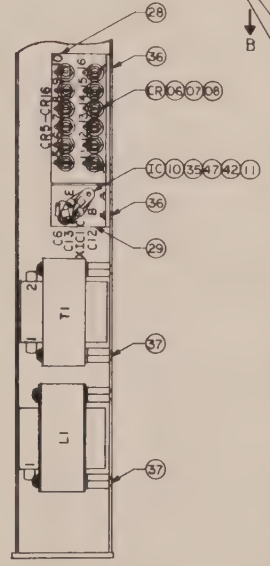
abacus controls inc.

DATE 11/20/84 REV
SHEET 5 OF 5

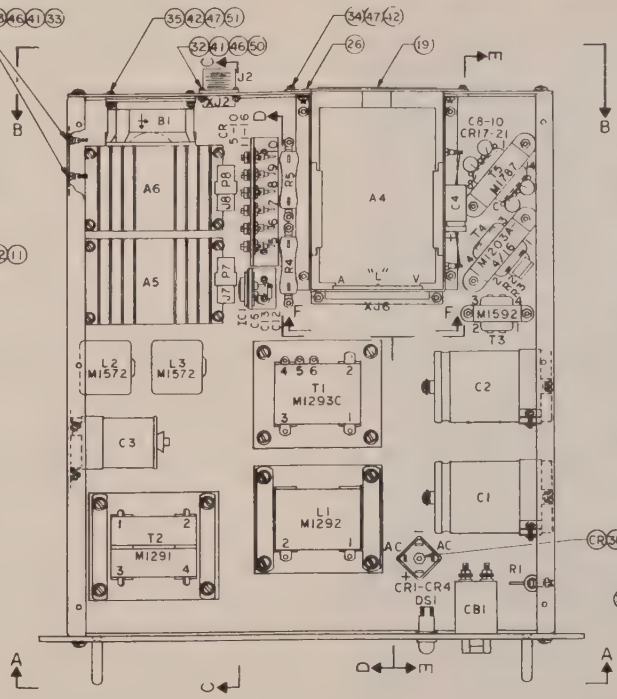
FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
41		#4 Flat Washer,SS		QPL	81349	MS15795-803	38
42		#6 Flat Washer,SS		QPL	81349	MS15795-805	46
43		#8 Flat Washer,SS		QPL	81349	MS15795-807	1
44		#10 Flat Washer,SS		QPL	81349	MS15795-808	6
45		#10 Flat Washer,Nylon		H.H. Smith	83330	2674	7
46		#4 Lockwasher,Split,SS		QPL	81349	MS35338-135	46
47		#6 Lockwasher,Split,SS		QPL	81349	MS35338-136	49
48		#8 Lockwasher,Split,SS		QPL	81349	MS35338-137	1
49		#10 Lockwasher,Split,SS		QPL	81349	MS35338-138	6
50		4-40 Nut,Hex,SS		QPL	81349	MS35649-244	24
51		6-32 Nut,Hex,SS		QPL	81349	MS35649-264	37
52		6-32 Nut,Hex,Self-Locking		QPL	81349	MS21083-006	3
53		8-32 Nut,Hex,SS		QPL	81349	MS35649-284	1
		*SCD-Source Control Drawing					



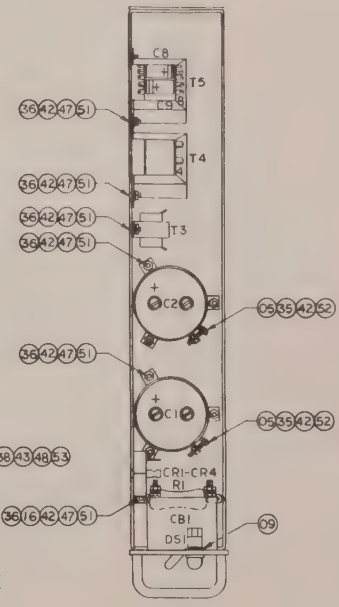
VIEW C-C



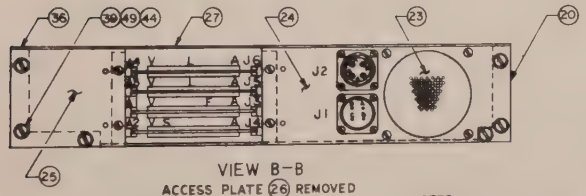
VIEW D-D



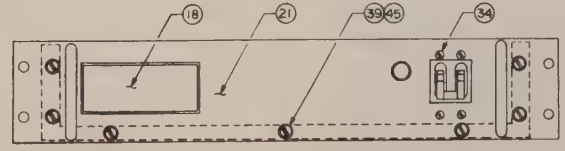
TOP VIEW
TOP COVER (27) REMOVED



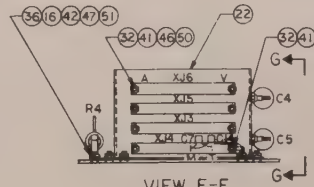
VIEW E-E



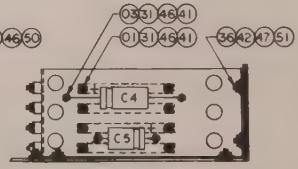
VIEW B-B
ACCESS PLATE (26) REMOVED



VIEW A-A



VIEW F-F



VIEW G-G

NOTES:

1. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY AND DO NOT NECESSARILY APPEAR ON THE COMPONENT/CHASSIS.
2. APPLY LOCKTITE, LOCKTITE CORP. P/N 242-21, OR EQUIV., TO THE THREADS OF ALL SCREWS WHERE THERE IS AN ABSENCE OF OTHER LOCKING HARDWARE (i.e. CB1, HANDLES, L1-L3, T1 & T2, ETC.).
3. INSTALL SPECIFICATION NAMEPLATE (19) CENTERED ON THE OUTSIDE OF THE CARD CAGE ACCESS PLATE (26) AFTER FINAL TEST AND PRIOR TO PACKAGING.

KEY/KEYWAY LEGEND	
CONN./PC. CARD	PIN
J6/A4	L
J5/A3	L
J3/A1	F
J4/A2	S

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE ON:
FRACTIONS ± 1/64 DECIMALS 3 PLC ±.010 2 PLC ± .03 ANGLES ± 1/2°
MATERIAL: REFER TO MAIN ASSEMBLY PARTS LIST NO. PL-152A-1.
FINISH: N/A

DRAWN BY: F. ROBBINS DATE: 11/5/84
CHECKED BY
APPROVAL (DRAFT)
APPROVAL (ENGR) 11/5/84
APPROVAL (QUALITY)

SCHEM.-402/3 NEXT ASSY | 7755 USED ON | APPLICATION

abacus controls inc

ASSEMBLY DRAWING
FREQUENCY CONVERTER
MODEL 152A-1

54241 | SIZE D | 42275

SCALE 1:2 | SHEET | OF

TITLE L.V. POWER SUPPLY MODULE
PL 21014

abacus controls inc.

DATE 11/20/84 REV
SHEET 1 OF 2

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
		Schematic		ACI	54241	21013	
		Assembly		ACI	54241	21014	
		Artwork		ACI	54241	20874	
		Marking		ACI	54241	20876	
		Drilling		ACI	54241	20875	
		P.C. Card		ACI	54241	20873	1
	C1	Not Used					
	C2	Not Used					
	C3	Capacitor,Ceramic	.22uF,50VDC	Kemet	31433	CK06BX224K	3
	C4	S/A C3					
	C5	Capacitor,Mica	1000pF,500VDC	QPL	81349	CM06FD102G03	1
	C6	Capacitor,Tant.	3.9uF,10VDC	Kemet	31433	T110A395K010	1
	C7	Capacitor,Tant.	.22uF,35VDC	Kemet	31433	T110C226M035AS	2
	C8	S/A C3					
	C9	S/A C7					
	CR1-7	Diode		QPL	81349	1N4003	7
	IC1	Not Used					
	IC2	Integrated Circuit		RCA	19089	CA339	1
	Q1	Not Used					
	Q2	Transistor		RCA	19089	2N5783	1

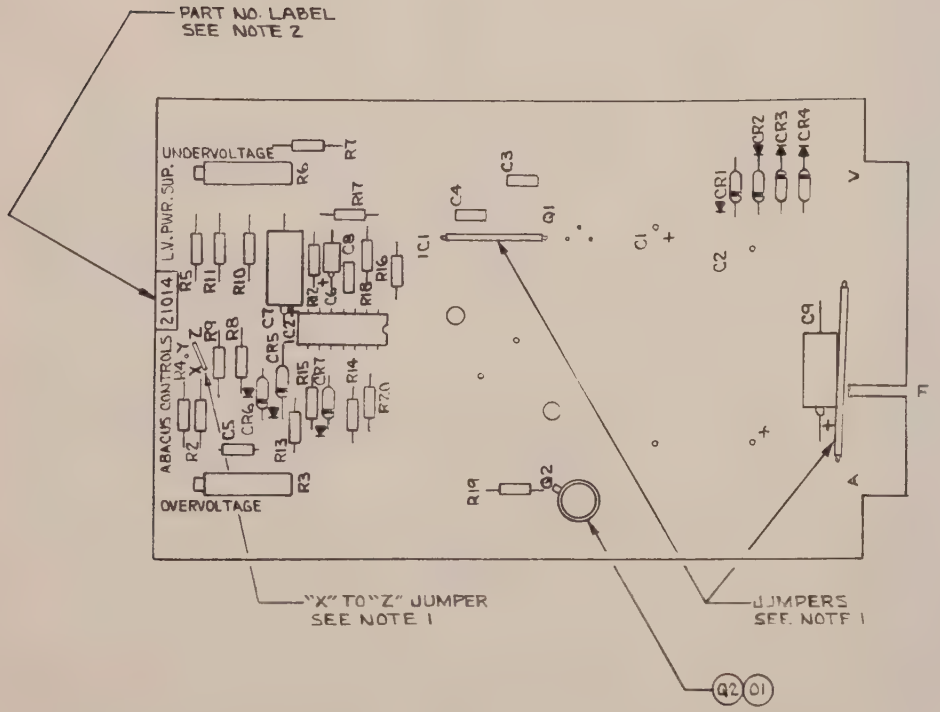
TITLE L.V. POWER SUPPLY MODULE
PL 21014

abacus controls inc.

DATE 11/20/84 REV
SHEET 2 OF 2

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	R1	Not Used					
	R2	Resistor,Precision	4020,1/4W,1%	QPL	81349	RN55D4021F	2
	R3	Potentiometer	5K,3/4W	Bourns	80294	3006Y-1-502	2
	R4	Resistor,Precision	5.11K,1/4W,1%	QPL	81349	RN55D5111F	2
	R5	Resistor,Precision	10K,1/4W,1%	QPL	81349	RN55D1002F	4
	R6	S/A R3					
	R7	S/A R4					
	R8	Resistor,Precision	56.2K,1/4W,1%	QPL	81349	RN55D5622F	2
	R9	S/A R8					
	R10	S/A R5					
	R11	S/A R5					
	R12	Resistor,Precision	66.5K,1/4W,1%	QPL	81349	RN55D6652F	1
	R13	Resistor,Precision	1.65K,1/4W,1%	QPL	81349	RN55D1651F	1
	R14	Resistor,Comp.,Fxd	18K,1/4W,10%	QPL	81349	RC07GF183K	1
	R15	Resistor,Comp.,Fxd	39K,1/4W,10%	QPL	81349	RC07GF393K	2
	R16	S/A R2					
	R17	S/A R5					
	R18	S/A R15					
	R19	Resistor,Comp.,Fxd	1K,1/4W,10%	QPL	81349	RC07GF102K	1
	R20	Resistor,Comp.,Fxd	330,1/4W,10%	QPL	81349	RC07GF331K	1
		Spacer,TO-39 Transistor (Q1-Q2)		AFE	54335	10200DAP	2
		NOTE: Install jumper from X to Z. Install jumper from pin B to pin M.					
		Install jumper from IC2-2 to pin J (midway along trace).					
		Refer to assembly drawing 21014 for proper location of all jumpers.					

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
A	COMPLETELY REDRAWN	11/8/84	



NOTES:

1. INSTALL THREE JUMPERS AS SHOWN ON THE MAIN DETAIL. ALL JUMPERS SHALL BE #22AWG B.T.C.W.. INSTALL TEFLON SLEEVING ON THE TWO LONGER JUMPERS. ALL JUMPERS SHALL BE INSTALLED ON THE FRONT (COMPONENT) SIDE OF THE P.C. CARD.
2. PREPARE PART NO. LABEL USING THE KROY 61 LABELING MACHINE AND THE HELVETICA MEDIUM, 10PT UNS CASSETTE. INSTALL OVER ORIGINAL SILKSCREENED PART NO. AS SHOWN.
3. COMPONENTS C1, C2, IC1, Q1 & R1 ARE NOT USED IN THIS CONFIGURATION.

	7755
	6657
SCHEM.- 21013	21
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± 1/64 | DECIMALS 3PLC ±.015, 2PLC ±.03 | ANGLES ±1/2°

MATERIAL REFER TO SUB-ASSY. PARTS LIST PL-21014

FINISH N/A

DRAWN F. ROBBINS 11/8/84

CHECKED

APPROVED 11/9/84

APPROVED

abacus controls inc.
80 READINGTON ROAD
P.O. BOX 893
SOMERVILLE, N.J
08876-0893

ASSEMBLY DRAWING
LOW VOLTAGE POWER SUPPLY MODULE
P.C. CARD

SIZE		
B	54241	21014
SCALE 1 : 1		SHEET 1 OF 1

TITLE LOGIC & CONTROL MODULE
PL 40262B-1J

abacus controls inc.

DATE 11/20/84 REV
SHEET 1 OF 4

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
		Schematic		ACI	54241	40261B-1J	
		Assembly		ACI	54241	40262B-1J	
		Artwork		ACI	54241	40263	
		Marking		ACI	54241	40265	
		Drilling		ACI	54241	40264	
		P.C. Card		ACI	54241	40262B	1
	C1	Capacitor,Ceramic	.01uF,100V	QPL	81349	CK12BX103K	5
	C2	Capacitor,Tant.	10uF,20V	Kemet	31433	T110B106K020AS	2
	C3	Capacitor,Tant.	1.5uF,10V	Kemet	31433	T110A115K010AS	1
	C4	S/A C1					
	C5	S/A C2					
	C6	Capacitor,Tant.	3.9uF,10V	Kemet	31433	T110A395K010AS	1
	C7	Capacitor,Tant.	56uF,15V	Kemet	31433	T110C566K015AS	1
	C8	Capacitor,Ceramic	.22uF,100V	QPL	81349	CK06B224K	3
	C9	S/A C1					
	C10	Capacitor,Mica	75pF,500V	QPL	81349	CM05ED750J03	2
	C11	S/A C8					
	C12	Capacitor,Mica	1000pF,500V	QPL	81349	CM06FD102J03	2
	C13	S/A C8					
	C14	S/A C10					
	C15	S/A C12					
	C16	Capacitor,Mica	200pF,500V	QPL	81349	CM05FD201J03	1
	C17	S/A C1					
	C18	S/A C1					

TITLE LOGIC & CONTROL MODULE
PL 40262B-1J

abacus controls inc.

DATE 11/20/84 REV
SHEET 2 OF 4

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	CR1-	Diode		QPL	81349	1N4003	15
	CR12						
	CR13	Not Used					
	CR14	Diode,Reference		Micro-Semi	12954	1N4682	1
	CR15-	Not Used					
	CR16						
	CR17-	S/A CR1					
	CR19						
	IC1	Integrated Circuit		National	27014	LM358	1
	IC2	Integrated Circuit		National	27014	LM319	1
	IC3	Integrated Circuit		TI	96214	SN7492	1
	IC4	Integrated Circuit		TI	96214	SN74393	1
	IC5	Integrated Circuit		ACI	54241	MMI10032B	1
	IC6	Integrated Circuit		RCA	19089	CA339G	1
	IC7	Integrated Circuit		TI	96214	SN74LS92N	1
	IC8	Delete-Note 1					
	IC9	Integrated Circuit	-5V,5%	Motorola	04713	MC79L05ACG	1
	IC10	Integrated Circuit		TI	96214	SN7414	1
	R1	Resistor,CC	3.9K,1/4W,10%	QPL	81349	RC07GF392K	14
	R2	Resistor,CC	4.7K,1/4W,10%	QPL	81349	C07GF472K	2
	R3	Resistor,Precision	115K,1/4W,1%	QPL	81349	RN55D1153F	1
	R4	Potentiometer	20K,3/4W,10%	Bourns	80294	3006Y-1-203	2
	R5	Resistor,Precision	10K,1/4W,1%	QPL	81349	RN55D1002F	1

TITLE LOGIC AND CONTROL MODULE
PL 40262B-1J

abacus controls inc.

DATE 11/20/84 REV
SHEET 3 OF 4

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	R6	Resistor,Precision	90.9K,1/4W,1%	QPL	81349	RN55D9092F	1
	R7	Resistor,Precision	5.11K,1/4W,1%	QPL	81349	RN55D5111F	1
	R8	S/A R4					
	R9	Delete					
	R10	Resistor,CC	390,1/4W,10%	QPL	81349	RC07GF391K	2
	R11	S/A R10					
	R12	S/A R1					
	R13	S/A R1					
	R14	Resistor,Precision	20.5K,1/4W,1%	QPL	81349	RN55D2052F	1
	R15	S/A R1					
	R16	Resistor,CC	10K,1/4W,10%	QPL	81349	RC07GF103K	6
	R17	S/A R1					
	R18	S/A R16					
	R19	S/A R16					
	R20	S/A R1					
	R21	S/A R16					
	R22	S/A R16					
	R23	S/A R1					
	R24	S/A R1					
	R25	S/A R1					
	R26	Delete					
	R27	Resistor,CC	39K,1/4W,10%	QPL	81349	RC07GF393K-Note 1	2
	R28	S/A R27					
	R29	S/A R1					
	R30	Delete and Jumper					
	R31	S/A R1					

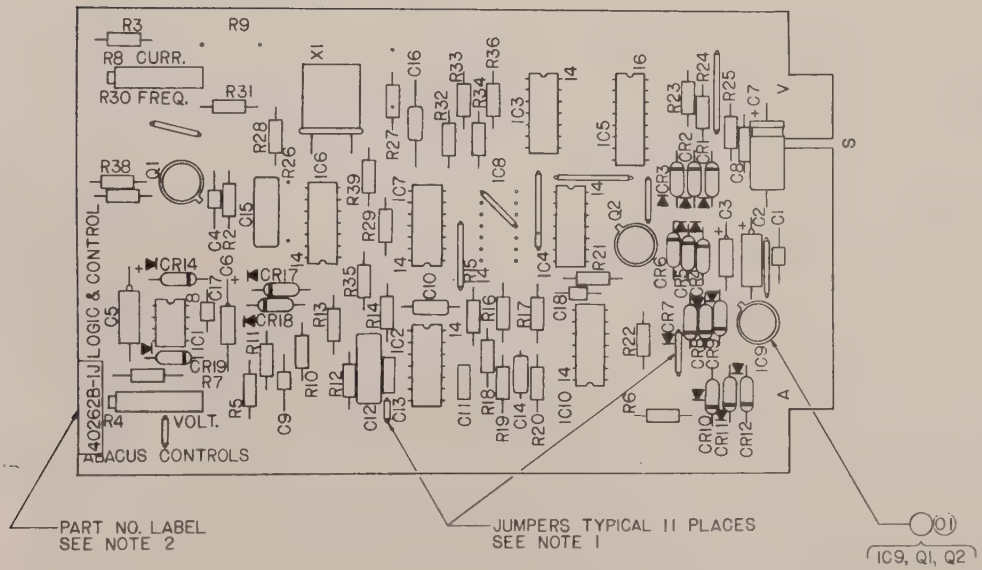
TITLE LOGIC AND CONTROL MODULE
PL 40262B-1J

abacus controls inc.

DATE 11/20/84 REV
SHEET 4 OF 4

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	R32	S/A R1					
	R33	S/A R16					
	R34	S/A R2					
	R35	S/A R1					
	R36	S/A R1					
	R37	Not Used					
	R38	Resistor,CC	6.8K,1/4W,10%	QPL	81349	RC07GF682K	1
	R39	Resistor,CC	100K,1/4W,10%	QPL	81349	RC07GF104K	1
	Q1	Transistor		QPL	81349	2N2905	1
	Q2	Transistor		QPL	81349	2N1711	1
	X1	Crystal	230.4KHz	Erie	32897	HC-32	1
		Spacer,TO-39 Transistor(IC9,Q1-Q2)		AFE	54355	10200DAP	3
		NOTE 1: Refer to assembly drawing 40262B-1J for locating and installing eleven (11) jumpers. R27 is installed in the inner most set of holes. Jumper R32 and R34 is connected to IC4-6 instead of IC4-5.					

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED



NOTES:

1. INSTALL ELEVEN (11) JUMPERS AS SHOWN ON THE MAIN DETAIL. ALL JUMPERS SHALL BE #22AWG B.T.C.W.. INSTALL TEFLON SLEEVING ON ALL JUMPERS. ALL JUMPERS SHALL BE INSTALLED ON THE FRONT (COMPONENT) SIDE OF THE P.C. CARD.
2. PREPARE PART NO. LABEL USING THE KROY 61 LABELING MACHINE AND THE HELVETICA MEDIUM, IOPT UNS CASSETTE. INSTALL OVER ORIGINAL SILK-SCREENED PART NO. AS SHOWN.
3. COMPONENTS CR13, CR15, CR16 & R37 ARE NOT USED. IC8, R9, R26 & R30 ARE DELETED FOR THIS CONFIGURATION.

	7755
SCHEM.	6657
40261B-IJ	21
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE ON:
FRACTIONS ± 1/64 | DECIMALS 3 PLC ±.010, 2 PLC ± .03 | ANGLES ± 1/2°

MATERIAL: REFER TO SUB-ASSY. PARTS LIST PL-40262B-IJ

FINISH: N/A

DRAWN BY	F. ROBBINS	DATE 11/15/84
CHECKED BY		
APPROVAL (DRAFT)		
APPROVAL (ENGR)	[signature]	11/15/84
APPROVAL (QUALITY)		

abacus controls inc

ASSEMBLY DRAWING
LOGIC & CONTROL MODULE
P.C. CARD

54241	SIZE D	40262B-IJ
SCALE 2:1		SHEET OF

TITLE DRIVER MODULE, P.C. CARD
PL 20143-1

abacus controls inc.

DATE 11/18/82 REV A
SHEET 1 OF 3

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.	MATERIAL & SPECIFICATION
		Schematic		ACI	54241	20100		
		Artwork		ACI	54241	20002		
		Drilling		ACI	54241	20003		
		Marking		ACI	54241	20004		
		Assembly		ACI	54241	20005		
		P. C. Board		ACI	54241	20002	1	
	C1	Capacitor, Disc	.22UF, 50V	QPL	81349	CK06BX224K	2	
	C2	Capacitor, Ceramic	.0047UF, 100V	QPL	81349	CK12BX472K	4	
	C3	S/A C1						
	C4	S/A C2						
	C5	S/A C2						
	C6	S/A C2						
	C7	Capacitor	.01UF, 50V	QPL	81349	CK12BX103K	1	
	CR1-10	Diode, Rectifier		QPL	81349	1N4003	10	
	IC1	Integrated Circuit		T.I.	06214	SN7405	1	
	IC2	Integrated Circuit		T.I.	06214	SN7414	1	
	Q1	Transistor		QPL	81349	2N2905	2	
	Q2	Transistor		Motorola	04713	2N6213	2	
	Q3	Transistor		RCA	19089	2N3440	4	
	Q4	S/A Q3						
	Q5	S/A Q1						

TITLE DRIVER MODULE, P.C. CARD
PL 20143-1

abacus controls inc.

DATE 11/18/82 REV A
SHEET 2 OF 3

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.	MATERIAL & SPECIFICATION
	Q6	S/A Q2						
	Q7	S/A Q3						
	Q8	S/A Q3						
	R1	Resistor, Carb., Fxd.	1K, ¼W, 10%	QPL	81349	RC07GF102J	6	
	R2	Resistor, Carb., Fxd.	330ohm, ¼W, 10%	QPL	81349	RC07GF331J	2	
	R3	Resistor, Carb., Fxd.	10K, 2W, 10%	QPL	81349	RC42GF103J	1	
	R4-7	Not Used						
	R8	Resistor, Carb., Fxd.	470ohm, ¼W, 10%	QPL	81349	RC07GF471J	8	
	R9	S/A R1						
	R10	Resistor, Carb., Fxd.	100ohm, ¼W, 10%	QPL	81349	RC07GF101J	2	
	R11	S/A R1						
	R12	S/A R8						
	R13	S/A R1						
	R14	Resistor, Carb., Fxd.	2K, 3W, 5%	QPL	81349	RW69V203	1	
	R15	S/A R8						
	R16	S/A R1						
	R17	Resistor, Carb., Fxd.	100ohm, 2W, 10%	QPL	81349	RC42GF101J	1	
	R18	S/A R1						
	R19	S/A R8						
	R20	S/A R8						
	R21	S/A R8						
	R22	S/A R8						
	R23	S/A R8						
	R24-25	Resistor, Carb., Fxd.	4.7K, ¼W, 10%	QPL	81349	RC07GF472J	2	
	R26	S/A R10						

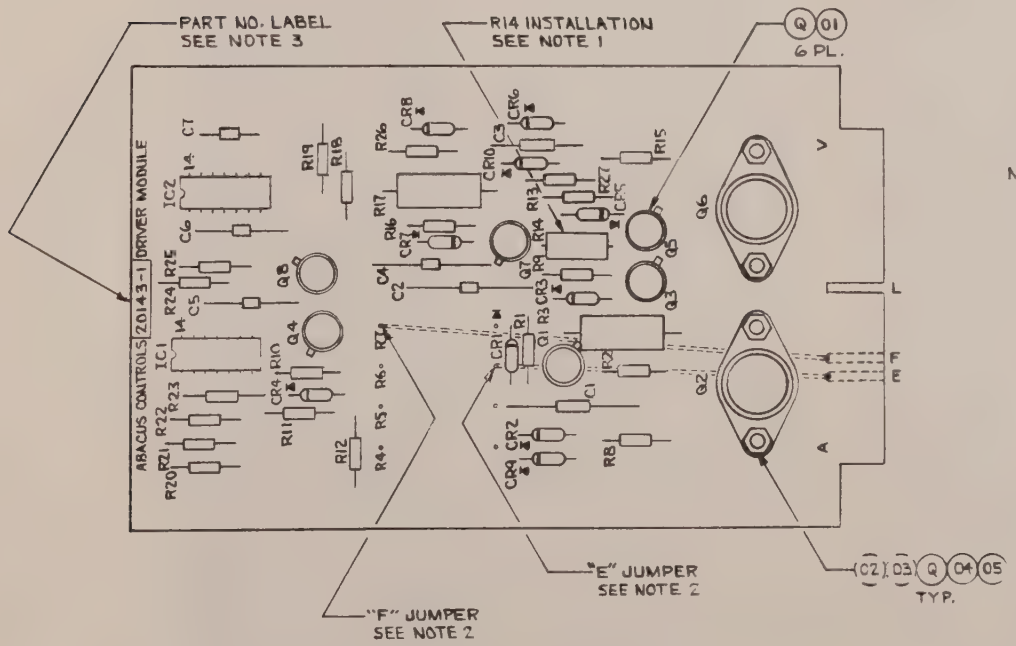
TITLE DRIVER MODULE, P.C. CARD
PL 20143-1

abacus controls inc.

DATE 11/18/82 REV A
SHEET 3 OF 3

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QTY.
	R27	S/A R2					
01		Spacer, TO-39 Transistor(Q1,Q3-5,Q7,Q8) AFE			54355	10200DAP	6
02		4-40 x 5/16 PHMS,SS		QPL	81349	MS51957-14	4
03		#4 Flat Washer, SS		QPL	81349	MS15795-803	4
04		#4 Lockwasher, Split, SS		QPL	81349	MS34338-135	4
05		4-40 Nut, Hex, SS		QPL	81349	MS35649-244	4
		NOTE: Refer to assembly drawing 20143-1, revision A, for jumper installation information.					

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
A	COMPLETELY REDRAWN	11/7/84	



NOTES:

1. BEND LEADS OF R14 (2K, 3W) TO FIT PREDRILLED HOLES AND ALSO, TO KEEP RESISTOR BODY OFF OF P.C. CARD A MINIMUM OF 1/16 IN..
2. INSTALL JUMPERS FROM PIN "E" TO PREDRILLED HOLE NEAR CR1 AND FROM PIN "F" TO PREDRILLED HOLE NEAR Q4 (MARKED R7). BOTH JUMPERS SHALL BE #22 AWG B.T.C.W. WITH TEFLON SLEEVING AND SHALL BE INSTALLED ON THE REAR (TRACE) SIDE OF THE P.C. CARD.
3. PREPARE PART NO. LABEL USING THE KROY 61 LABEL MAKER AND THE HELVETICA MEDIUM, 10PT ONE CASSETTE. INSTALL OVER ORIGINAL SILKSCREENED PART NO. AS SHOWN.
4. COMPONENTS R4, R5, R6 & R7 ARE NOT USED IN THIS CONFIGURATION.

	7755
	6657
SCHEM. 20199	21
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± 1/64, DECIMALS 3PLC ± .015 2PLC ± .03, ANGLES ±1°
MATERIAL REFER TO SUB-ASSY. PARTS LIST PL-20143-1
FINISH N/A

DRAWN F. ROBBINS 11/7/84
CHECKED
APPROVED 11/8/84
APPROVED

abacus controls inc.
80 READINGTON ROAD
P.O. BOX 863
SOMERVILLE, N.J.
08876-0863

ASSEMBLY DRAWING
DRIVER MODULE
P.C. CARD

SIZE		
B	54241	20143-1
SCALE 1 : 1		SHEET 1 OF 1

TITLE POWER MODULE ASSEMBLY
PL 20798

abacus controls inc.

DATE 11/17/82 REV
SHEET 1 OF

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QT
		Schematic		ACI	54241	10538	
		Assembly		ACI	54241	20798	
	CR1,2	Diode		QPL	81349	1N3893	2
	Q1,2	Transistor	TO-3	QPL	81349	2N6547	2
	R1,2	Resistor, Flameproof	47,2W, 5%	QPL	81349	RL42S470J	2
		SPECIAL ASSEMBLY ITEMS:					
01		Heatsink		ACI	54241	41630	1
02		Insulator, DO-4 Diode	(CR1,CR2)	Bergquist	55285	7403-09FR-22	2
03		Terminal Lug, Solder	(CR1,CR2)	Zierick	79963	520	2
04		Washer, Nylon Shoulder	(CR1,CR2)	H.H. Smith	83330	2666	2
05		Insulator, TO-3	(Q1,Q2)	Bergquist	55205	7403-09FR-04	2
06	XQ1,2	Socket, Transistor	(Q1,Q2)	Robert Nugent	06776	MP-3452-T	2
07		Terminal Lug, Solder	#6(Q1,Q2)	H.H. Smith	83330	1414-6	2
08	E1,2	Standoff, Insul. Turret		CTC	71279	570-3500-01-01-00	2
09		Connector, Plug		Molex	87504	03-09-2092	1
10		Terminal, Male		Molex	87504	02-09-2103	9
		GENERAL HARDWARE:					
11		4-40 x 3/8 PHMS,SS		QPL	81349	MS51957-15	2
12		6-32 x 5/8 PHMS,SS		QPL	81349	MS51957-31	4

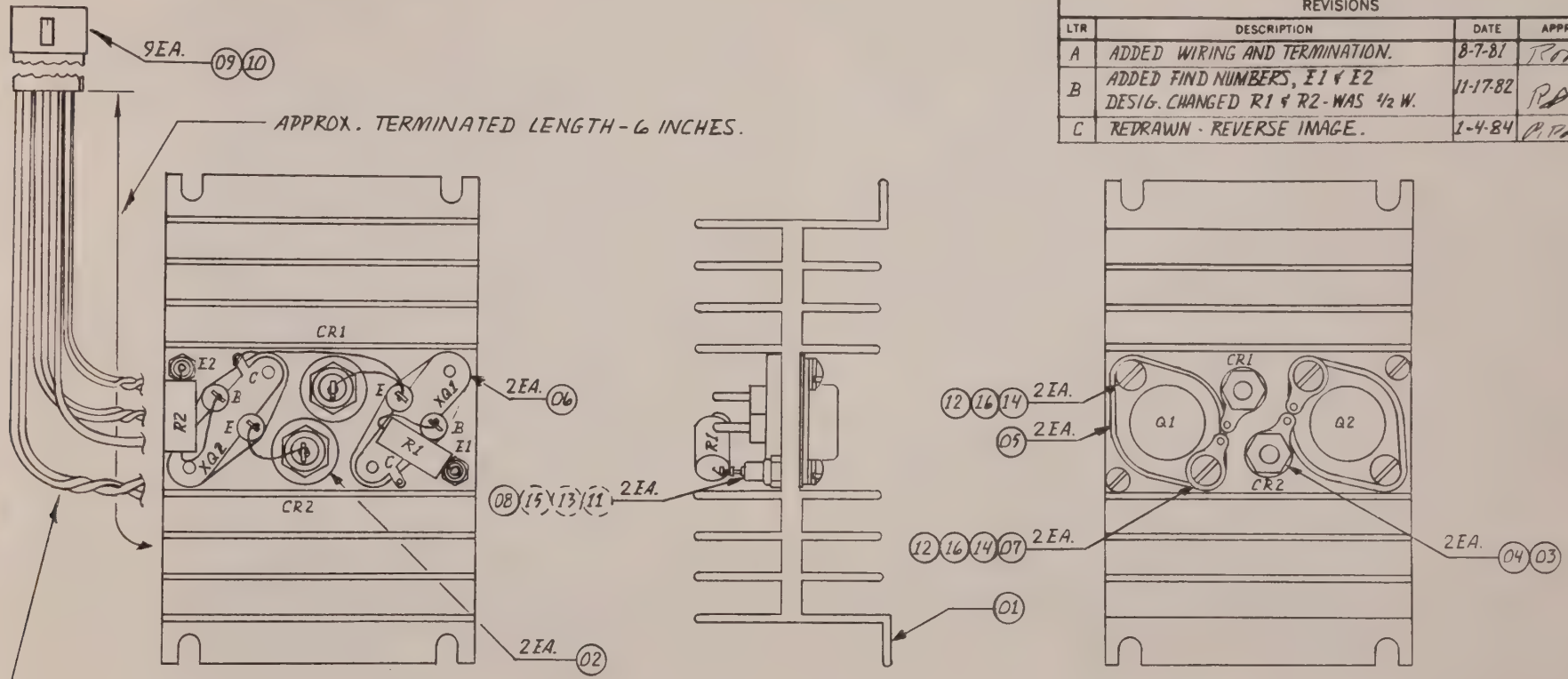
TITLE POWER MODULE ASSEMBLY
PL 20798

abacus controls inc.

DATE 11/17/82 REV B
SHEET 2 OF 2

FIND NO.	REF. DESIG.	DESCRIPTION	VALUE	VENDOR	CODE IDENT. NO.	PART NO.	QT
13		#4 Flat Washer, SS		QPL	81349	MS15797-803	2
14		#6 Flat Washer, SS		QPL	81349	MS15795-805	4
15		#4 Lockwasher, Split,	SS	QPL	81349	MS35338-135	2
16		#6 Lockwasher, Split,	SS	QPL	81349	MS35338-136	4

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
A	ADDED WIRING AND TERMINATION.	8-7-81	
B	ADDED FIND NUMBERS, E1 & E2 DESIG. CHANGED R1 & R2 - WAS ½ W.	11-17-82	
C	REDRAWN - REVERSE IMAGE.	1-4-84	



ALL WIRES SHOWN ORIENTED FOR CLARITY ONLY.

NOTE:
CR1, CR2, Q1 & Q2 ARE INSULATED FROM HEAT SINK.

SEE SCHEMATIC # 10538 FOR WIRING.

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ± 1/64 ± .005 ±1° 2°	ORIG. CPY. DTD.	9.12.79	abacus controls inc | 80 READINGTON ROAD | SOMERVILLE N J 08876
			DRAWN F. DAY	1-84	ASSEMBLY DRAWING POWER MODULE
		MATERIAL REFER TO SUB-ASSY. PARTS LIST NO. PL-20798	CHECKED		
42275	7755		APPROVED		
41621	6657	FINISH N/A	APPROVED		SIZE B | 54241 | 20798
	21				SCALE 1:1 | SHEET 1 OF 1
NEXT ASSY.	USED ON				
APPLICATION					

abacus controls inc.

P.O. Box 893
SOMERVILLE, N.J. 08876-0893
201-526-6010

W A R R A N T Y

Abacus Controls Inc. warrants each instrument manufactured by it to be free from defects in material and workmanship. Our liability under this warranty is limited to repairing or replacing any instrument or part thereof, except fuses and batteries, which shall, within one year after date of shipment to the original purchaser, be returned to us, in original cartons or equivalent, with transportation charges prepaid, prove after our examination to be thus defective. Our warranty for this instrument is rendered void if the unit has been abused or has been modified, unless such modifications have been made in accordance with written instructions received from Abacus Controls Inc. Repaired equipment will be returned prepaid to the customer with an invoice for transportation costs and repair charges if applicable.

Telephone guidance in troubleshooting and repairing products in the field will be made available at no cost to the customer for a period of one year. Repair parts and subassemblies will be sent prepaid at the expense of Abacus Controls Inc. to the addresses designated by the customer.

Abacus Controls Inc. reserves the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

Abacus Controls Inc. shall not be liable for any operational delays or consequent damages under this warranty. There shall be no other obligation expressed or implied.